

EXHIBIT 6

1 RYAN R. SMITH, State Bar No. 229323
rsmith@wsgr.com
2 WILSON SONSINI GOODRICH & ROSATI PC
701 Fifth Avenue, Suite 5100
3 Seattle, WA 98104
Telephone: 206.883.2500
4 Facsimile: 206.883.2699

5 CHRISTOPHER D. MAYS, State Bar No. 266510
cmays@wsgr.com
6 ALEXANDER R. MILLER, State Bar No. 347827
alex.miller@wsgr.com
7 WILSON SONSINI GOODRICH & ROSATI PC
650 Page Mill Road
8 Palo Alto, CA 94304-1050
Telephone: 650.493.9300
9 Facsimile: 650.565.5100

10 Attorneys for Defendant
SC MARKETING GROUP, INC.

1 I, Radhakrishnaiah Parachuru, declare as follows:

2 1. I am over eighteen (18) years of age. I was retained by defendant-counterclaim
 3 plaintiff SC Marketing Group, Inc. (dba Thermal Shipping Solutions “TSS”) to conduct certain
 4 analyses in relation to TSS’s RENEWLINER product. I submit this Declaration in support of TSS’s
 5 notice of motion and motion for summary judgment of invalidity. I have personal knowledge of the
 6 facts set forth herein and, if called as a witness, could and would testify competently thereto.

7 2. I hold B.S., M.S., and Ph.D. degrees in Textile Technology and a M.S. degree in
 8 Decision Sciences with a major in Applied Statistics. A true and correct copy of my Curriculum
 9 Vitae detailing my educational background and experience is attached hereto as Exhibit A.

10 3. I first joined the School of Textile and Fiber Engineering of Georgia Tech located in
 11 Atlanta, GA in December 1988 as Research Scientist – I, a position I held for six years. I then
 12 served as Research Scientist – II for six years, Senior Research Scientist for eight years, and
 13 Principal Research Scientist for nine years. The School of Textile and Fiber Engineering merged
 14 with the School of Materials Science and Engineering in the year 2010. After the merger, I served
 15 as Principal Research Scientist and Senior Academic Professional. My major responsibilities at
 16 Georgia Tech over the years were in the areas of teaching, research, safety coordination, and public
 17 service and industry support. I also taught a wide range of manufacturing and characterization
 18 courses during my Georgia Tech tenure, including the Nonwovens Technology course. I recently
 19 retired from my position as Principal Research Scientist & Senior Academic Professional. After
 20 retirement, I assumed emeritus status at Georgia Tech and still continue to maintain an advisory role
 21 and professional associations with the school.

22 4. I am the author of numerous peer reviewed journal articles. These articles were
 23 published before, during and after my Georgia tech tenure. A list of my published articles appears
 24 in Exhibit A. I have also presented papers at professional conferences on topics within my areas of
 25 scholarship and interest. A list of my publications, presentations, and papers appears in Exhibit A.
 26 I am also the author of chapters in books published by AATCC (American Association of Textile
 27 Chemists & Colorists) and other sources.

1 5. I am a Senior Member of the American Association of Textile Chemists and Colorists
 2 and have served as Chairman of the Statistics Committee since 2008. I have also been a member of
 3 the Fiber Society since 1990 and am a Senior Member of the Textile Quality Control Association.
 4 I am a life member of the Textile Association of India and life member of the Institution of Engineers
 5 of India.

6 6. Exhibit B provides a list of matters in which I served as a subject expert. About six
 7 or seven of the litigation matters required deposition (indicated by *) and four required court-room
 8 testimony (indicated by **). The remaining cases in the list were settled on the basis of mutual
 9 consensus. Either the expert report or the oral opinion provided by me or by the expert on the
 10 other side of the litigation served as the main impetus for the consensus-based settlement. I have
 11 not participated in any deposition or court-room testimony within the last four years.

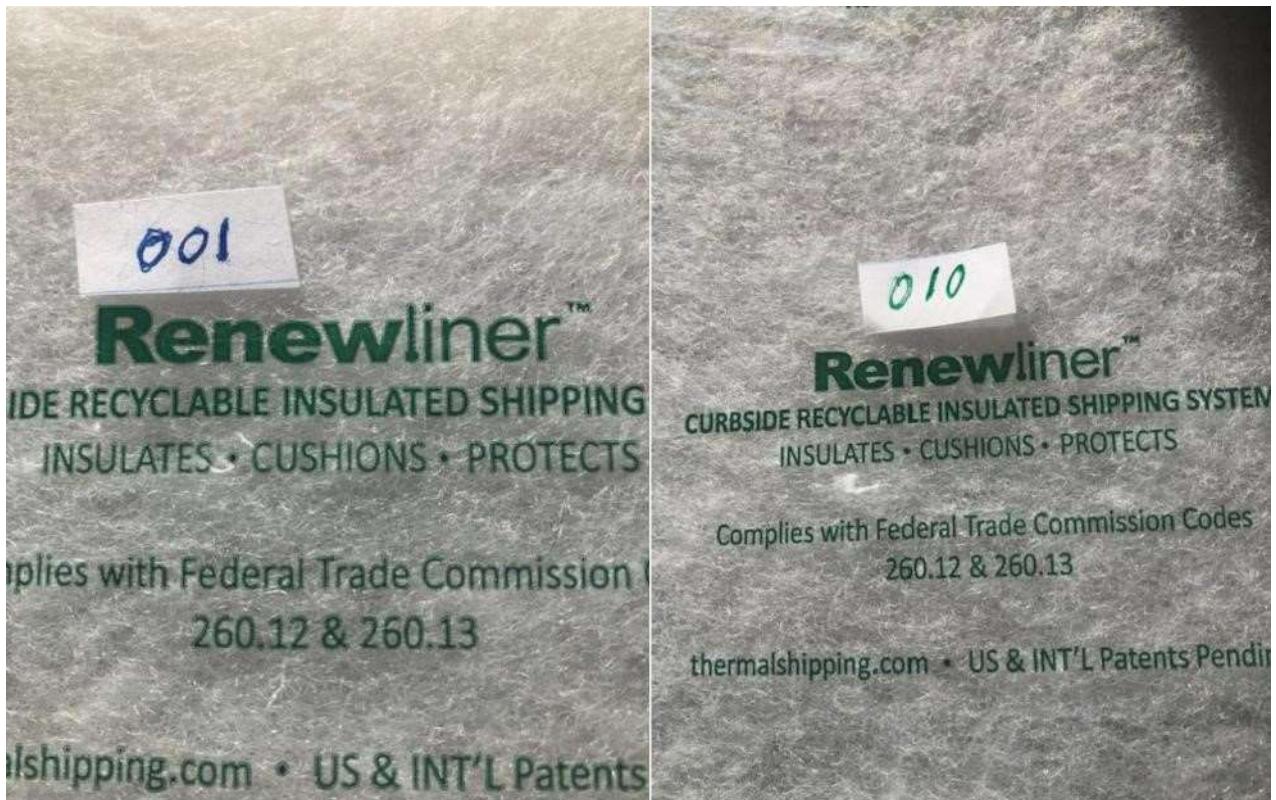
12 7. I was retained by TSS as a technical expert in this matter to conduct certain analyses
 13 in relation to TSS's RENEWLINER product. My hourly billing rate on this matter is \$545 for
 14 consultation, \$645 for deposition and trial testimony, and \$150 for travel time. My compensation
 15 is not dependent on the opinions I offer or the outcome of this matter.

16 8. In January 2024, I analyzed two samples of TSS's RENEWLINER product, one
 17 that I have been informed was manufactured in 2023 (001) and the other that I have been informed
 18 was manufactured in 2016 (010). The analysis was undertaken to determine if the two products
 19 are materially similar in terms of construction and composition.

20 9. By "materially similar in terms of construction and composition," I refer to what is
 21 claimed in United States Patent No. 11,078,007 ("the '007 Patent"), which I understand to be the
 22 sole patent asserted by the Plaintiff in this case. I have read the '007 Patent and its claims. In
 23 analyzing materially similarity, I was informed by the allegations and assertions contained in
 24 Plaintiff's Amended Disclosure of Asserted Claims and Infringement Contentions dated December
 25 21, 2023 ("Amended Infringement Contentions"). As such, my analysis included assessing what
 26 difference exists between the 2016 and 2023 samples of RENEWLINER with respect to the
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1 construction and composition of RENEWLINER that Plaintiff alleged in its Amended
 2 Infringement Contentions infringe the '007 Patent.

3 10. Digital camera pictures of the fully assembled samples are shown in Figure 1
 4 below.



18 Figure 1: 2023 Renewliner Sample (Left) and 2016 Renewliner Sample (Right).

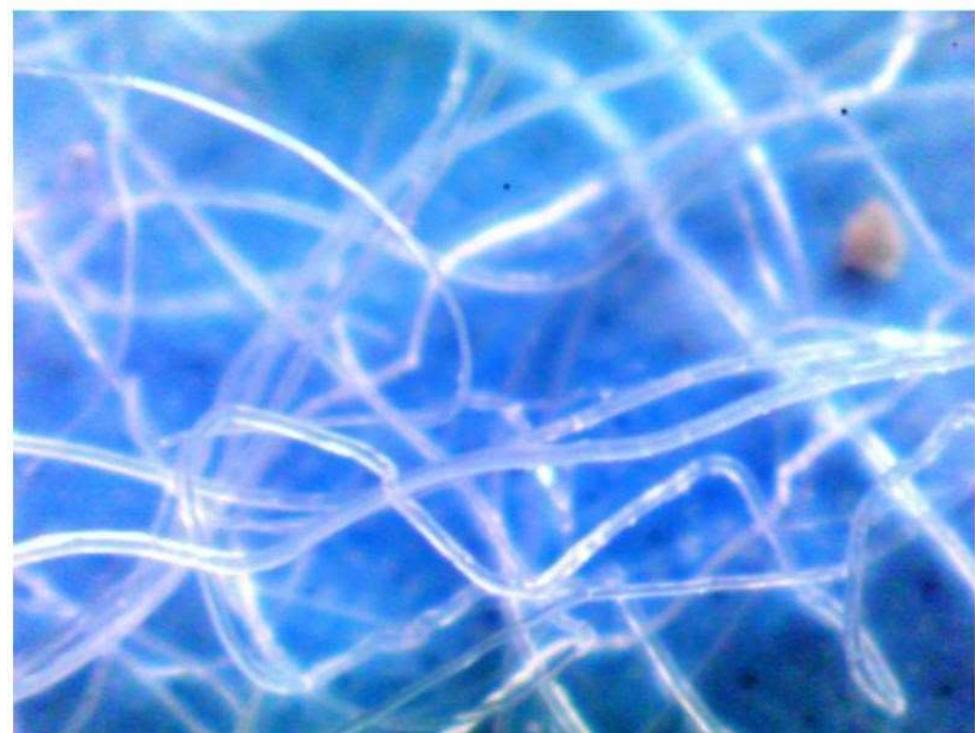
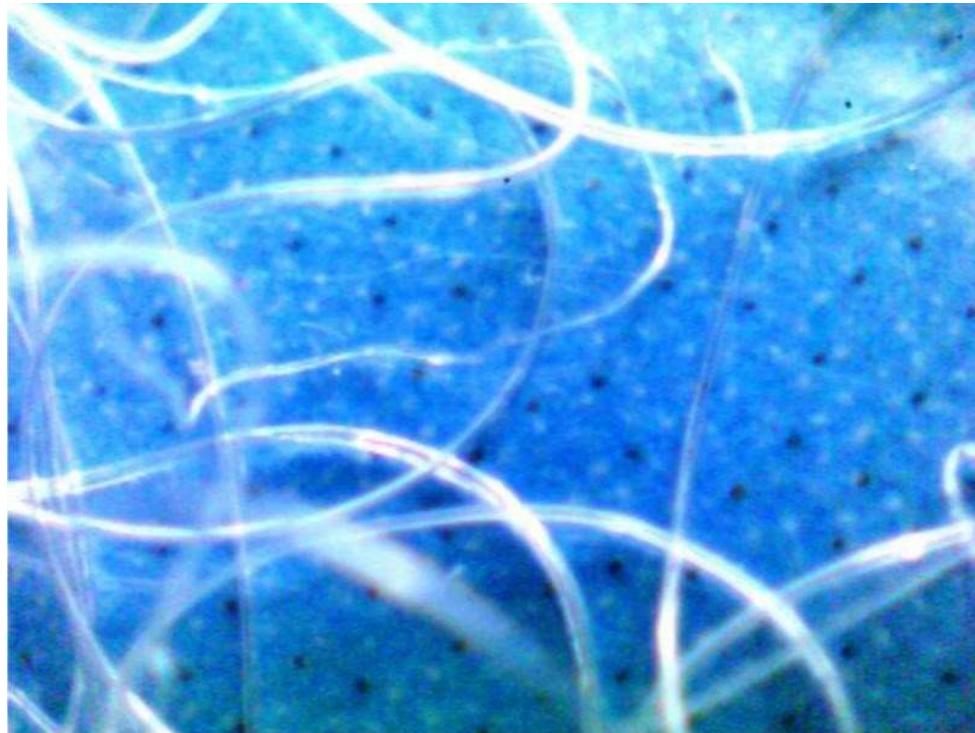
19 11. Yarn/fiber denier is defined as mass in grams of 9000-meter length. Yarn denier
 20 is normally measured by taking several meters length of yarn and weighing it. This method of
 21 measurement is not suitable for measuring the denier of fibers/yarns used in the bats because
 22 sufficient length of yarn cannot be retrieved without damage. After ascertaining that the bulk
 23 (majority) fibers in both 001 and 010 bats were beginning to melt around 245 degrees Celsius, I
 24 concluded that both are polyester fibers. After ascertaining that they both are polyester fibers, I
 25 proceeded to look at fiber diameters under the microscope because I knew the diameters would be
 26 the same for two polyester fibers of the same denier. Therefore, to characterize denier,
 27 construction, and structural similarity, my analysis mostly depended on microscopy. Microscopic
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1 imaging is the most commonly used technique to look at the inner arrangement and structural
2 aspects of nonwoven webs. Magnified images of fibers removed from both samples were obtained
3 at two different magnifications of 100x and 400x. Magnified images revealed the diameters of the
4 fibers used and also the manner in which the fiber segments are glued together to maintain the
5 structural integrity and resilience of the thick bats. Having already determined that the bulk fibers
6 of both samples melt around 245 Celsius and the binder fibers of both samples also melt at a lower
7 but similar temperature, I have determined that the same type of bulk and binder fibers are used in
8 both samples. In order to have further confirmation on the fiber types of the bulk and binder fibers
9 of the two samples, I used a near infrared (NIR) scanning technique to scan on the surfaces of the
10 two pad samples. Infrared scans of the two samples are obtained in absorption and reflection
11 modes. Both absorption and reflection patterns obtained through infrared scanning experiments
12 reflect overall fiber composition and internal arrangement of fibers. In addition to microscopic
13 images and infrared scans, I also took non-magnified images of the two samples (001 and 010)
14 using a digital camera. Surface images obtained through digital camera illustrate the appearance
15 of the two fully assembled products in their assembled state, and also the nature of arrangement of
16 fibers on the two surfaces. Camera images captured along the thickness direction of the bats
17 illustrate the manner in which the thickness of the bats is built up to maintain a stable and resilient
18 porous structure. Microscopic images of the two samples taken at 100X and 400x, digital camera
19 images obtained on the pad surface and pad thickness direction, and near infrared scans obtained
20 in the absorption and reflection mode are used in the following pages of this declaration.
21 Additional images that were generated in the imaging process but not included in this declaration
22 are also being made available in Exhibit C.

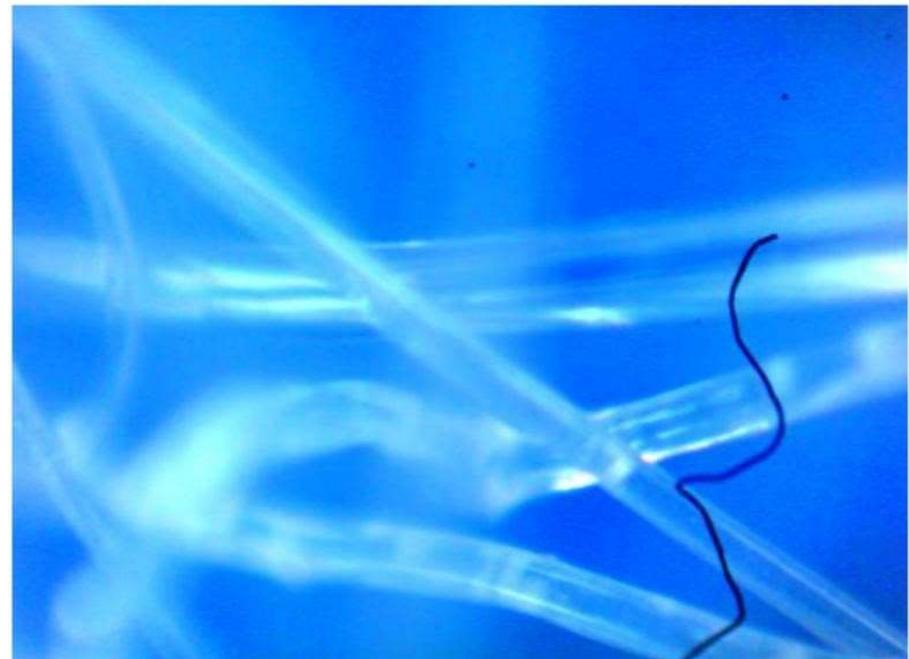
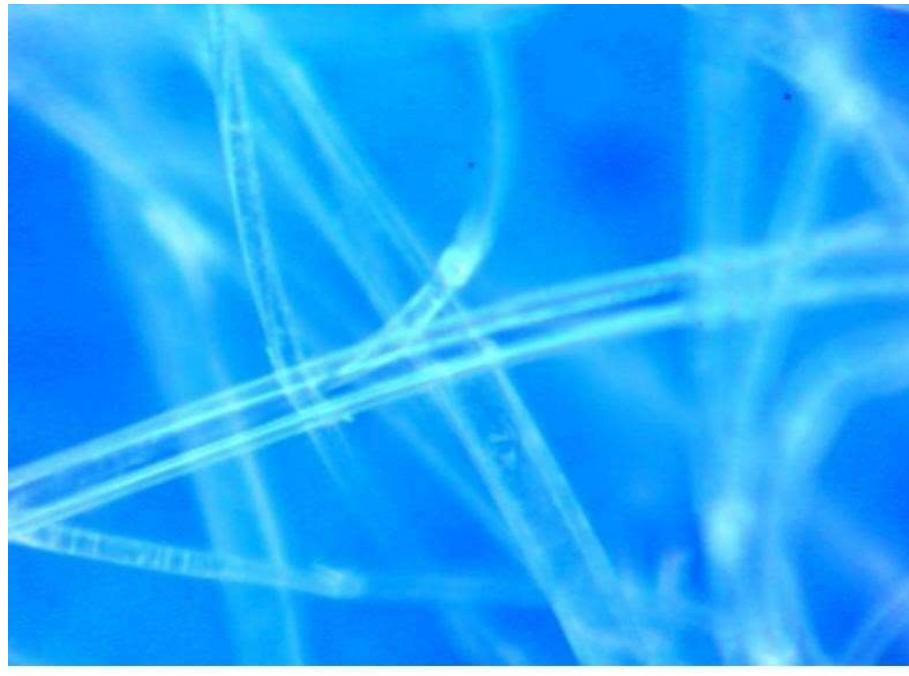
23 12. Based on my analysis, I arrived at the following conclusions, to a reasonable degree
24 of scientific certainty, with respect to these two samples:

25 a) Based on the microscopy images, I conclude that the fiber diameters of the
26 bulk fibers and the binder fibers used in samples 001 and 010 are the same. This implies that the
27
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1 fiber deniers are also the same. Images of the diameters of each sample at 100x and 400x are shown
2 in Figures 2-4 below:



27 Figure 2: 2023 Renewliner at 100x (top); 2016 Renewliner at 100x (bottom). Both images show
28 mostly the smaller diameter (bulk) fibers. It can be seen that the diameters are the same.



23 Figure 3: 2023 Renewliner Sample at 400x (top); 2016 Renewliner Sample at 400x (bottom). Both
24 small diameter (bulk) and large diameter (binder) fibers are visible. It can be seen that the diameters
25 of both small and large fibers are the same. Occasional melt spots on fibers and molten sticking
26 points can also be seen.
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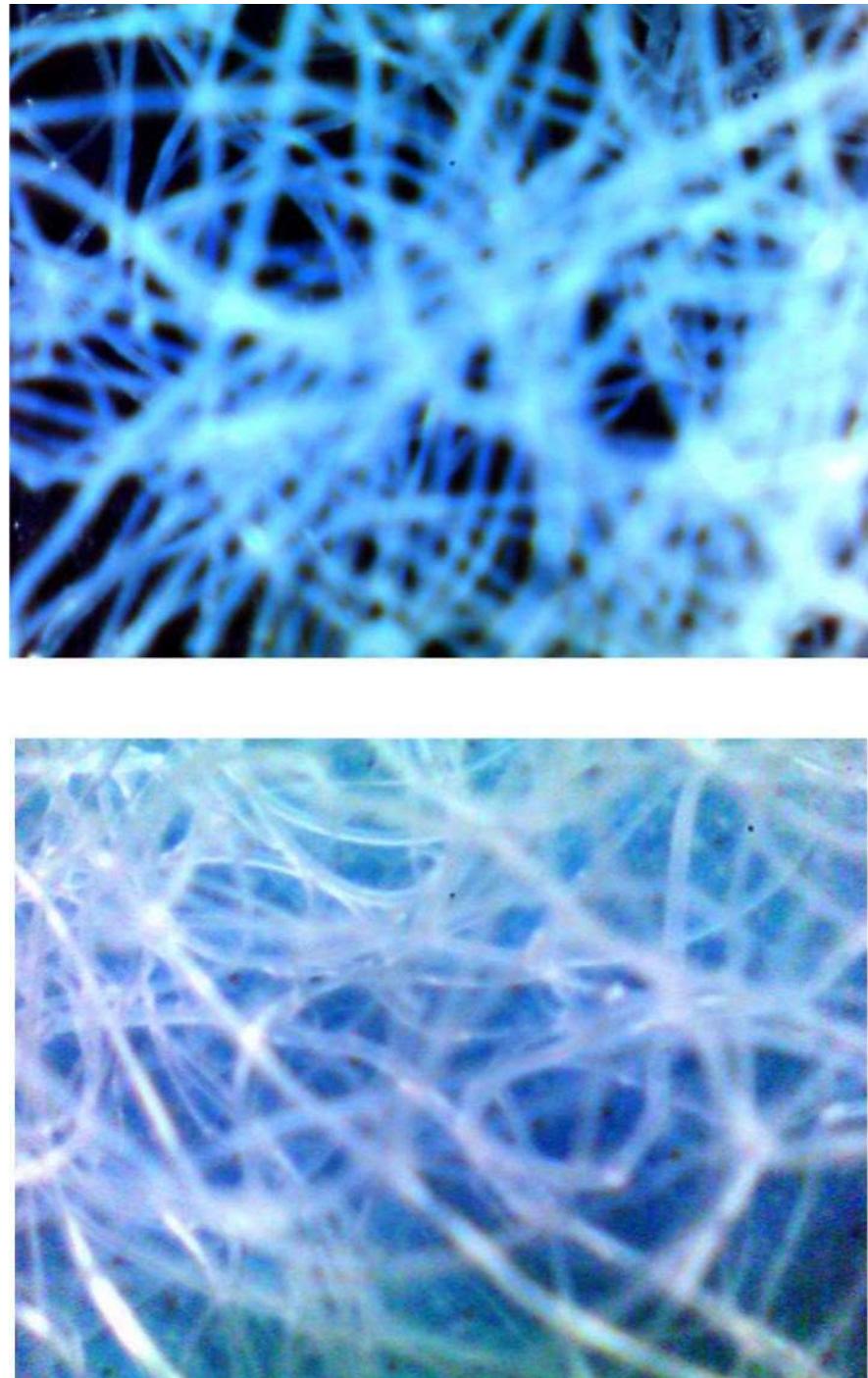
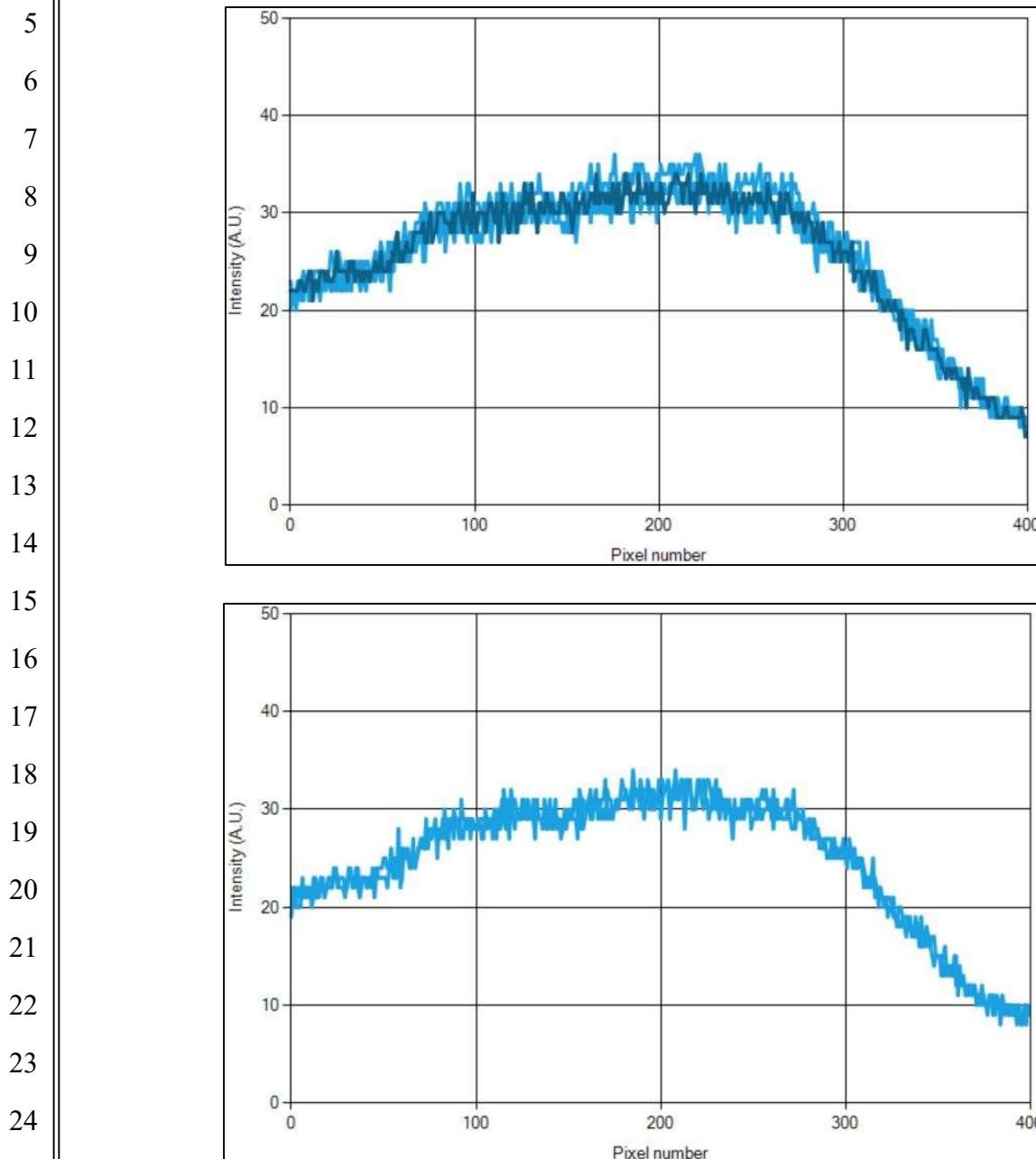


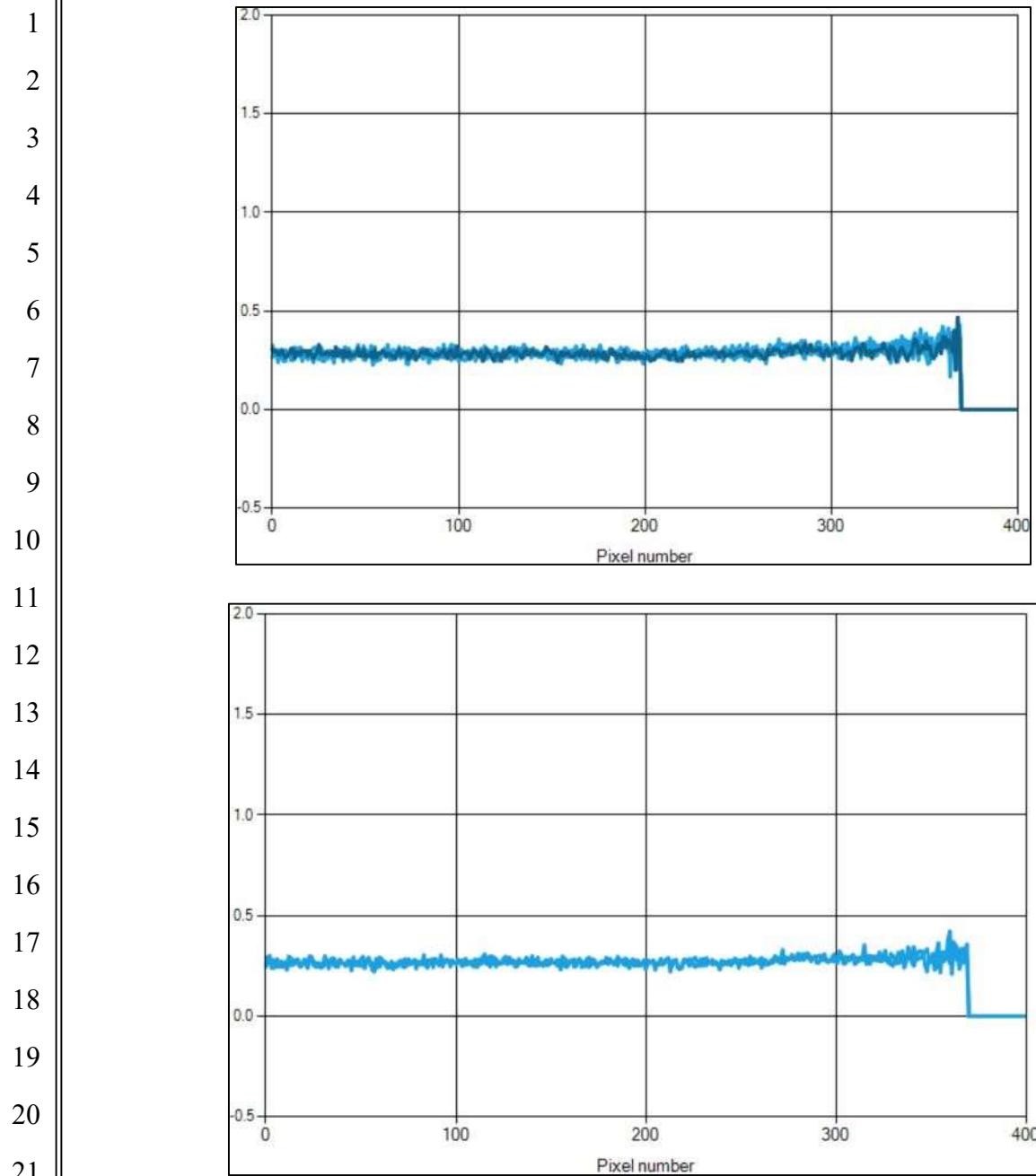
Figure 4: 2023 Renewliner Sample at 100x (top); 2016 Renewliner Sample at 100x (bottom). Images show more dense areas of both samples. Both small (bulk) and large diameter (binder) fibers can be seen. Fiber diameters appear to be the same. Occasional melt spots on fibers and molten drip spots from binder fibers can also be seen.

b) I also observed that the shapes of infrared absorption and infrared reflection plots of sample 001 and 010 are very similar, as shown in Figures 5 and 6 below. Because of this,

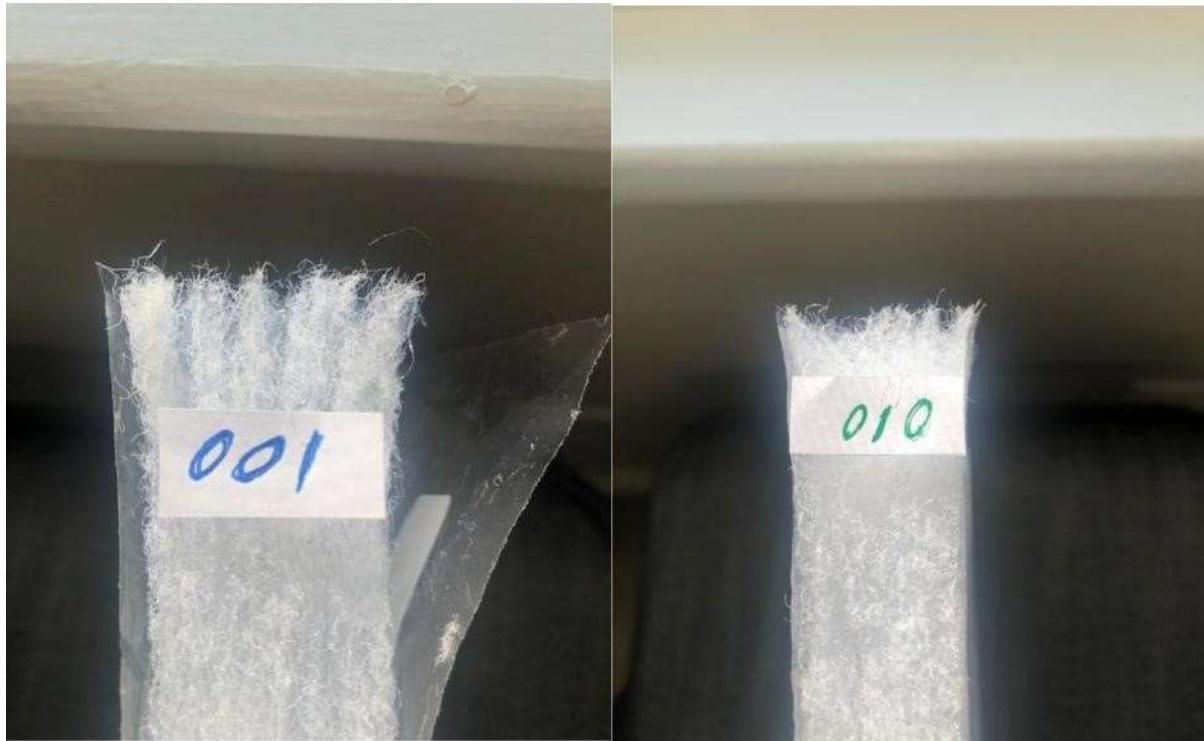
1 I conclude that the chemical identity and the composition of both fiber types (binder and bulk
 2 fibers) and their composition is either identical or very close to each other. Similarity of the shapes
 3 of absorption and reflection curves also implies that the overall porosity and micro arrangement of
 4 fibers in the two samples is very similar and close to each other.



25 Figure 5: 2023 Renewliner Sample (top) and 2016 Renewliner Sample (bottom). For both samples,
 26 multiple super imposed plots of infrared light absorption intensity versus wavelength (frequency)
 27 are shown. The fact that the multiple plots taken from different spots lie one on top of the other
 implies structural integrity. Structural and material identity is indicated by the similar shape of the
 28 two absorption plots.



22 Figure 6: 2023 Renewliner Sample (top), 2016 Renewliner Sample (bottom). For both samples,
23 multiple super imposed plots of infrared light reflection versus wavelength (frequency) are shown.
24 The fact that the multiple plots taken from different spots of the samples lie one on top of the other
25 implies structural integrity. Structural and material identity is indicated by the similar shape of the
26 two reflection plots. Both absorption and reflection behaviors are a reflection of material
27 composition (bulk fibers, binder fibers and solidified sticking points). Shape similarity of the plots
28 of the 2023 and 2016 Renewliner Samples suggests that the samples' material composition is likely
identical.



16 Figure 7: 2023 Renewliner Sample (left); 2016 Renewliner Sample (right). Illustration of multi-
 17 layered bat thickness build mode in both 2023 and 2016 samples. Layers are a little thicker in the
 2023 sample's bat, which has more overall thickness than the 2016 sample's bat. However, I have
 observed that Thermal Shipping offers the Renewliner in a variety of different thickness.¹

19 13. My methodologies for reaching the conclusions described in this Declaration are
20 described in paragraphs 8-11 above and the results corresponding to the stated procedures are
21 presented in paragraph 12 above.

22 14. In my professional and academic experience, and in connection with my service on
23 scientific committees and based upon my review of peer-reviewed literature in the field, the
24 methodologies and processes described herein are generally accepted and deemed reliable within
25 the scientific community of the United States.

²⁷ ¹ Plaintiff's Amended Infringement Contentions do not make reference to thickness of the bat as being a material consideration.

1 I declare under penalty of perjury under the laws of the United States of America that the
2 foregoing is true and correct. Executed on January 4, 2024 in Pleasant Hill, CA 94523.
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5 By: *P. Radhakrishnaiah*
6 Radhakrishnaiah Parachuru

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TABLE OF CONTENTS

EXHIBIT	DESCRIPTION
A.	Curriculum Vitae
B.	List of Court Cases Attended in Recent Years
C.	Additional Images Taken During the Analysis of RENEWLINER Samples 001 and 010

EXHIBIT A

RADHAKRISHNAIAH PARACHURU (KRISHNA)
Principal Research Scientist (Adjunct Status as of August 2022)
School of Materials Science and Engineering
Krishna.parachuru@mse.gatech.edu; rparachuru@gmail.com; 404-906-5049 (C)

I. EARNED DEGREES

MS - Decision Sciences with a major in Applied Statistics, Georgia State University, Atlanta, GA 1993-95.

PhD - Textile Engineering, Indian Institute of Technology, New Delhi, India, 1976-80.

MS - Textile Technology, University of Madras, India, 1973-75.

BS - Textile Technology, University of Madras, India, 1968-73.

II. EMPLOYMENT HISTORY

12/88 - 11/94 **Research Scientist - I**
11/94 - 07/02 **Research Scientist - II**
07/02 - 09/11 **Senior Research Scientist**
09/11 - 11/10 **Principal Research Scientist**
11/10 – 07/2022 **Senior Academic Professional/Principal Research Scientist**
08/22 - Present **Principal Research Scientist (Emeritus Status)**

School of Materials Science and Engineering, Georgia Institute of Technology, Atlanta, GA.

Teaching at the undergraduate level has been one of the major responsibilities since Jan '92. Taught both theory and lab courses in the areas of yarn formation, weaving, knitting, fiber science, nonwovens, physical testing and quality control. Academic responsibility shifted from full-time research to teaching & research as a result of achieving consistently high teaching evaluations.

After the School of Polymer & Fiber Engineering merged with the School of Materials Science and Engineering in 2010, I have been serving as one of the main instructors for two laboratory based MSE core courses (MSE 3021-Materails Laboratory-I, which focuses on materials characterization, and MSE 4022-Materials Laboratory-II, which focuses on materials fabrication). Two other non-laboratory courses I began to teach in recent semesters are MSE 3720-Introduction to Polymer and Fiber Enterprise and MSE 2001-Principles and Applications of Engineering Materials. Both courses are taken by all undergraduate majors at GT and MSE 2001 is a required course for all engineering majors.

Research activity comprised planning and execution of several basic and applied research projects in the fiber-product manufacturing area, and objective evaluation of the performance of fiber-based products such as yarns, fabrics, garments, carpets and other miscellaneous fiber products. I made use of national/international recognition in the KES applications area to procure unique Japanese equipment (KES equipment) worth \$1.5 million for a token price of \$25,000. This acquisition enabled the creation of a new research laboratory, and truly unique research capabilities at Georgia Tech. In the initial years, most of the support for the research activity came from a self-initiated industrial consortium (GT Kawabata Consortium). As coordinator of this consortium, I worked closely with dozens of textile companies and completed close to 120 developmental projects, some of which carried basic research value. Defined new ways of

applying KES techniques for product and process optimization in the textile and allied industries. Guided US denim manufacturers in incorporating new product monitoring procedures for the attainment of superior quality finished products. Advised graduate students on their dissertation work and served as the main advisor (committee chair) of nine graduate students. Made close to 65 presentations in national and international conferences and published several papers in leading research journals.

Served as the **Coordinator of Public Service/Industry Support** activities of TFE/PTFE schools and continue to serve as the coordinator of the industry support activities of MSE. Services rendered to the industry include testing of raw materials and finished products, technical trouble shooting, process optimization, design & development of new products, and assessment of new technologies.

Took additional responsibility as **MSE Safety Coordinator** after PTFE merged with MSE in the year 2010. Currently I maintain and supervise eight MSE undergraduate labs and I am also responsible for the safety of all MSE labs (36 labs located in five different buildings). I have formulated a set of safety policies and procedures for MSE and I take responsibility not only for enforcing the safety regulations but also for the dissemination of information on the in-house safety policies and procedures.

5/85 -12/88 Post-doctoral Research Associate, College of Textiles, N.C. State University, Raleigh.

Functioned as principal researcher in two major areas - application of instrumental techniques for the objective evaluation of the handle and comfort properties of textile fabrics and design of state-of -the-art fiber products with engineered functional performance for apparel and non-apparel end uses.

- 1) Study of the relationships between the structural parameters of woven, knitted and nonwoven fabrics and their properties such as thermal insulation and conductivity, absorption and retention of moisture, softness and compressibility, surface roughness, surface friction, and mechanical behavior.
- 2) Fourier analysis of fabric surfaces to characterize surface texture, roughness and frictional properties.
- 3) Subjective and objective evaluation of the handle, comfort, and aesthetic characteristics of woven and knitted fabrics made from ring, rotor, air-jet and friction spun yarns.
- 4) Study of the influence of chemical and mechanical treatments on the softness, handle and comfort characteristics of apparel fabrics.
- 5) Characterization of the thermal protective performance of fabric composites made of high-performance fibers.
- 6) Comparative evaluation of the new yarn manufacturing systems and their products.

2/84 - 7/85 Professor of Textile Technology

7/80 - 1/82 Assistant Professor of Textile Technology

P. S. G. College of Technology, University of Madras, Coimbatore, India.

Taught graduate and undergraduate courses. Conducted research in the area of structure and properties of yarns. Coordinated research activities at the graduate level and played a major role in expanding and updating research facilities through grants obtained from government and private funding agencies. Participated in the revision and updating of graduate and undergraduate curricula.

1/82 - 2/84 Technical Manager, Telengana Textile Mills, Andhrapradesh, India.

Was responsible for the planning, erection and commissioning of the first fully air-conditioned state-of-the-art OE spinning mill, which installed the latest OE spinning machinery.

1/76-6/80 Senior Research Fellow (Lecturer 6/79-6/80), Indian Institute of Technology, New Delhi, India.

Taught yarn manufacturing and textile testing courses at the undergraduate level. Conducted tutorials and laboratory classes. Worked for Ph.D. degree in the area of structure of OE yams.

5/73-9/73 Technical Trainee, Anglo-French Textile Mills Limited, Pondicherry, India.

Received shop-floor orientation in weaving and quality control departments.

7/80-6/85 Textile Consultant - Offered expert services to three different textile mills located in Coimbatore on part-time basis. Services rendered include technical trouble shooting, product and process optimization, planning for modernization and renovation, preparation of feasibility reports and interaction with the technical staff of the mills.

III. HONORS AND AWARDS

Received major contributor award in the applied research category from a global Korean company which collaborative research with Georgia tech for 5 years (2003)

Received 'Best Proposal of the Year' award from the National Textile Center in the manufacturing technologies category for the proposal on 'Card-Spinning' project (Dec 1998)

Received 'Best Project of the Year' award from the government of the state of Tamilnadu in the textile technology category for the graduate student project, 'Design and Fabrication of a Pedal Operated Single Head, Self-pumping Type Rotor Spinning Machine for Application in the Home Spinning Sector'. (November 1985)

IV. RESEARCH SCHOLARSHIP AND CREATIVE ACTIVITIES

A. PUBLISHED BOOKS AND BOOK CHAPTERS

Text Book on Apparel Comfort to be published by Woodhead Publishing (Under Print)

Chapter: Mechanical Failure of Fiber and Polymer Materials and Fabricated Products
in Textile Laboratory Manual published by AATCC, Raleigh, NC (March 2022).

Chapter: New technology and materials for textile comfort

- Introduction
- Fiber modification for textile comfort
- PCM (phase change materials) used for textile comfort
- Nanotechnology for textile comfort
- Other
- Future trends
- Sources of further information and advice
- References

Chapter: Testing and evaluation of textile properties related to comfort

- Introduction
- Requirements
- International standards
- Heat stress for protective clothing
- Certification
- Sources of further information and advice
- Future trends
- References

B. REFERRED PUBLICATIONS AND SUBMITTED ARTICLES

Parachuru, R., 'Selected Research Briefs on the Fabrication of Value-Added Composites Using Recycled Textile Waste as Reinforcement Material,' Novel Research in Sciences, Vol. 14, Issue 3, March 2023

Parachuru, R., 'Textile Structures are Ideal Substrates for Nano Particle Finishes and they Permit Major Improvement in Performance Properties', J. Text. Sci. & Engg., Vol 13:1, 2023.

Parachuru, R., 'Textile Structures are Ideal Substrates for Nano Particle Finishes and they Permit Major Improvement in Performance Properties', J. Text. Sci. & Engg., Vol 13:1, 2023.

Parachuru, R. and Lavanya Krishnan, 'Recent Advances in Skin Care Enabled by the New Developments in Nanotechnology and Nanomaterial Fields' - (**Parts I & II**, Submitted for Publication)

Parachuru, R., 'The Role of Material Selection and Design on The Sleep Quality and Performance of Bedding Products', (accepted for publication in J. Text. Sci. & Engg.)

Parachuru, R., 'Review of the Recent Advances in the Fabrication and High-End Application of Textile-Based Microfluidic Devices' - (Accepted for Publication)

Parachuru, R. (2022). A comprehensive Look at the Current and Future Technologies Suitable for At-Home Detection and Management of Viruses and Virus Causing Diseases; **Parts I &II** (accepted for publication- Biosensors and Bioelectronics).

Parachuru R., 'Engineered High-End Performance Mattresses and Pillows and Their Influence on Sleep Quality, Quality of Life and Human Performance', Proceedings of Global Summit on Advances in Materials, Physics and Chemical Science, July 2022.

Rohan Ukhade and Radhakrishnaiah Parachuru, ,A Comprehensive Look at the Detection, Monitoring, and Control of Environmental Pollution with Particular Focus on New and Emerging Solutions to Address the Problem', Journal of Material Sciences & Engineering, Vol 10:12, 2021.

Julia Roberts and R. Parachuru, 'New and Emerging Smart Materials and Their Applications: A Review', J. Matls. Sci. & Engg., Vol. 10:9, 2021.

Vagott J, Parachuru R (2019): An Overview of Recent Developments in the Field of Wearable Smart Textiles. J Textile Sci & Eng 8: 368. doi: 10.4172/2165- 8064.1000368. Available: <https://www.omicsonline.org/open-access/an-overview-of-recent-developments-in-the-field-of-wearable-smart-textiles-2165-8064-1000368.pdf>

Parachuru, R. and Lavanya Krishnan, 'Clothing as an Affordable Means of Preventing Skin Cancer', AATCC Research Review, Sept. 2017.

The effect of fabric structure and yarn-to-yarn liquid migration on liquid transport in fabrics, S. Mhetre & Radhakrishnaiah Parachuru, J Text. Inst, Vol. 101, Issue 7, 2010, 621-626.

On the relationship between ink-jet printing quality of pigment ink and the spreading behavior of ink drops, S. Mhetre, W. Carr & P. Radhakrishnaiah
J Text. Inst, Vol. 101, Issue 5, 2010, 423-430.

Study of the Performance Properties of Carpets Containing Nylon 6 and Nylon 66 Face Yarns, (No co-authors) Text. Res. J. 75(2), 157-164 (2005)

Hand Related Mechanical Behavior of Enzyme treated Yarns, Part I: Role of Spinning System, Text. Res. J. 75(3), 265-273 (2005) (Jingwu He, Fred L. Cook and Gisela B. Diller are the co-authors

Hand Related Mechanical Behavior of Enzyme Treated Yarns, Part II: Influence of Fiber Disposition, Text. Res. J. 75(4), 293-296 (2005) (J. Jingwu He, Fred L. Cook and Gisela B. Diller are the co-authors

Cellulase Treatment of Durable Press Finished Cotton Fabric: Effects on Fabric Strength, Abrasion Resistance and Handle, Text. Res. J. 73(12), 1057-1062 (200e) (C. Q. Yang, W. Zhou and Gary Lickfield are the co-authors)

Mechanical Agitation of Fabrics during Enzyme Treatment and its Effect on the Measured Tactile Properties of the Treated Fabrics, Text. Res. J. **69**, 708-713, (1999) (with Xiaomin Meng, Gan Huang, G. Buschle Diller, and William Walsh)

Comparative Evaluation of Cotton-Covered Cotton/Polyester Yarns and Denim Fabrics Representing Different Spinning Technologies (Accepted for publication in Text. Res. J. James W. Rose, Thanh Khanh Tran, and A. P. S. Sawhney are the co-authors – delayed publication at the request of the sponsoring company)

Low-Stress Mechanical Behavior of Cotton/Polyester Yams and Fabrics Representing Differences in Fiber Distribution Within the Yarn, Text. Res. J. **66**, 99-103 (1996)

Properties of Fabric Made with Tandem Spun Yam, Text. Res. J. **66**, 607-611 (1996) (with A.P.S. Sawhney, L. B. Kimmel, and T. Tyndall)

Handle and Comfort Properties of Plain Weave Fabrics Made from High Performance Fibers, Proceedings of the 24th International Textile Research Symposium at Mount Fuji, 30-36, 1995.

The Relationship Between the Bulk of a Relaxed Skein and the Tactile Properties of the Resultant Woven and Knitted Fabrics, Proceedings of the 24th International Textile Research Symposium at Mount Fuji, 74-79, 1995.

A Comparative Evaluation of the KES Tensile Tester as a Predictor of the Residual Growth/Shrinkage in Pre-shrunk Cotton Fabrics, Proceedings of the 24th International Textile Research Symposium at Mount Fuji, 98-103, 1995.

SDAS: A Knowledge-based Framework for Analyzing Defects in Apparel Manufacturing, J. Text. Inst. **85**, 542-561, 1994 (with Phiroze Dastoor, R. Srinivasan, and Sundaresan Jayaraman)

Relationship between KES Properties and Sewing Performance of Difficult-to-Sew Woven Fabrics, Proceedings of the First International Clothing Conference, July 9-11, 1990, University of Bradford, U.K., (Sundaresan Jayaraman is co-author).

Handle and Comfort Properties of Woven Fabrics Made from Random Blend and Cotton-Covered Cotton/Polyester Yarns, Text. Res. J. **63**, 573-580, (1993) (with Sukasem Tejatanalert and A.P.S. Sawhney).

Production and Evaluation of Cotton/Viscose Yarns With Long Staple Viscose Fibers on the Surface and in the Body of the Yarn, Text. Res. J. **61**, 755-759 (1991).

In Vivo Cutaneous and Perceived Comfort Response to Fabric Part I: Thermophysiological Comfort Determination of Experimental Knit Fabrics, Text. Res. J. **60**, 405-412, 1990, (with K.L. Hatch, S. S. Woo, Roger L. Barker and Others).

In Vivo Cutaneous and Perceived Comfort Response to Fabric Part II:

Mechanical and Surface Related Comfort Determination of Experimental Knit Fabrics, Text. Res. J.60, 490-494, 1990, (with Roger L. Barker, K.L. Hatch and others).

In Vivo Cutaneous and Perceived Comfort Response to Fabric Part III: Water Content and Blood Flow in Human Skin under Garments Worn by Exercising Subjects in a Hot, Humid Environment, Text. Res. J. 60, 510-519, 1990, (with K. L. Hatch and others).

In Vivo Cutaneous and Perceived Comfort Response to Fabric Part IV: Perceived Sensations to Three Experimental Garments Worn by Subjects Exercising in a Hot, Humid Environment, Text. Res. J. 60, 561-568, 1990, (with K.L. Hatch and others).

Assessment of the Tactile Properties of Woven Fabrics Made from Various Types of Staple-fiber Yarn, J. Text. Inst. 79, 32-52, 1988, (with Peter R. Lord).

A Comparison of Various Woven Fabrics Containing Friction, Rotor and Ring Spun Cotton Yarn Fillings, Text. Res. J.58, 354-362, 1988, (with Peter R. Lord).

Tenacities of Plied Friction-spun, Rotor-spun and Ring-spun Yarns, J. Text. Inst. 78, 140-142, 1987, (with Peter R. Lord).

Assessment of Sheath Fiber Percentage and the Contribution of Sheath Fibers to Yarn Strength in Rotor-spun Viscose and Polyester Yarns, Institution of Engineers (India) Journal - ND.66, 64-69, 1985.

Influence of Process and Machine Variables on the Blend Characteristics of Rotor-spun Yarns Indian Journal of Textile Research 8,37-39, 1983, (with A. K. Sengupta and B. Dutta).

Influence of Fiber Parameters on the Migration and Blend Characteristics of Rotor-spun Yarns Indian Journal of Textile Research 8, 40-42, 1983, (with A. K. Sengupta and B. Dutta).

Techno-economic Viability of Aerofeed System under Indian Conditions, J. Text. Assn. 44, 57-62, 1983.

Effect of Using Filaments of Different Extensibilities on the Surface and in the Body of a Short Staple Cotton Yarn, Institution of Engineers (India) Journal -ND.63, 87-91, 1982.

Influence of Belts on Tensile Properties of Rotor-spun Yarns, Text. Res. J. 51,70-71,1981, (with A. K. Sengupta and B. Dutta).

Studies on Fiber Belts in Rotor-spun Yarns, Text. Res. J.50, 228-230, 1980, (with A. K. Sengupta and B. Dutta).

C. OTHER PUBLICATIONS AND CREATIVE PRODUCTS

Research Reports Prepared at North Carolina State University

Title: Development of a Wear Model for Cotton and Cotton/Polyester Sheeting Fabrics Using KES Test Data (with Roger L. Barker).

Member Company: The Proctor & Gamble Company, Cincinnati, Ohio (Jan 1988)

Title: KES Properties of Nonwoven Interlining Materials (with Roger L. Barker)

Member Company: The Pollen Company, New York (Dec. 1987)

Title: Comfort Characteristics of Nonwoven Fabrics Used as Protective Clothing in Chemical and Allied Industries (with Sang Sun Woo and Roger

Member Company: The Kendall Company, Barrington, Illinois (October 1987)

Title: Physical and Thermal Characteristics of Special Nonwoven Materials Suitable for Industrial Applications (with Roger L. Barker)

Member Company: Kimberly-Clark Corporation, Roswell, Georgia (September 1987)

Title: Hand and Comfort Characteristics of Knit Fabrics Made from Regular and Modified Polyester Staples (with Sang Sun Woo and Roger L. Barker)

Member Company: Dupont de Nemours & Company, Wilmington, Delaware (August 1987)

Title: KES Properties of High Bulk Knit Fabrics Representing Different Process Conditions (with R.L. Barker)

Member Company: The National Spinning Company, Washington, North Carolina (August 1987)

Title: Comfort Properties of Nonwoven Fabrics Used as Operating Room Apparel (with Sang Sun Woo and Roger L. Barker)

Member company: The Kendall Company, Barrington, Illinois (July 1987)

Title: Hand and Comfort Characteristics of Cotton/Polyester and Cotton/Wool Fabrics Corresponding to Ring and Rotor Spinning Systems (with Roger L. Barker)

Member Company: Cotton Incorporated, Raleigh, North Carolina (May 1987)

Title: Evaluation of Fabric Softening Treatments Using Kawabata Equipment (with Roger L. Barker)

Member Company: The Proctor & Gamble Company, Cincinnati, Ohio (April 1987)

10) Title: Hand and comfort Characteristics of Active Wear Fabrics Made from Regular and Modified Viloft Fibers (with Roger L. Barker)

Member Company: Courtaulds PLC, London (March 1987)

Title: KES Properties of Finished Polyester/Cotton Fabrics Containing Ring and Air Jet Yarns (with Roger L. Barker)

Member Company: The J. C. Penney Company, New York (February 1987)

Title: Judging the Quality of Automotive Fabrics Using KES Data (with Roger L. Barker)
Member Company: The General Motors Corporation, Inland Division, Warren (February 1987)

Research Reports Prepared at Georgia Institute of Technology

Title: Application of KES Methods to Optimize the Properties of Resin Treated Viscose Rayon Fabrics Used in the Construction of Armory Bags
Member Company: Imperial Chemical Industries (July, 1989)

Title: Characterization of the Low-Stress Mechanical Properties and Thermal Behavior of Knitted Fleece Fabrics Used in Winter Clothing Applications
Member Company: Russell Corporation, Alexander City, AL (September 1989)

Title: Study of the Influence of Raw Materials and Construction Parameters on the Compression and Resilience Properties of Assembled Carpets
Member Company: Dow Chemicals, Dalton, GA (December 1989)

Title: Investigation of the Relationship Between the Low-Stress Mechanical Properties and the Cutting and Sewing Performance of Denim Fabrics
Member Company: Swift Textiles, Columbus, GA (March 1989)

Title: Effect of Special Mechanical Treatments on the Properties of Nonwoven Materials
Member Company: Kimberly-Clark Corporation, Roswell, GA (February 1990)

Title: Influence of Loom Design Parameters and Operating Conditions on the Low-Stress Mechanical Behavior and Tactile Quality of Denim Fabrics
Member Company: Swift Textiles, Columbus, GA (March 1990)

Title: Study of the Influence of Loom Design Parameters and Operating Conditions on the Aesthetic Characteristics of Superior Quality Suiting Materials
Member Company: Dominion Textiles, Ontario, Canada (July 1990)

Title: An Analysis of the Relationship between KES Properties and the Sewing Performance of Denim Fabrics
Member Company: Levi-Strauss & Co., San Francisco (August 1990)

Title: Prediction of the Growth potential of Pre-shrunk Denim Fabrics Through the Energy Recovery Measurements Made on the Kawabata Tensile Tester
Member Company: Greenwood Mills, Liberty, SC (January 1991)

Title: The Use of Two-Way Shearing Test for the Prediction of Skewness in Wet Relaxed Single Jersey Fabrics
Member Company: Hoechst Celanese, Charlotte, NC (January 1991)

Title: Application of Bending and Shear Tests to Characterize the Residual

Forces Present in Right and Left-Hand Twills and Evaluation of the Influence of Residual Forces on Tactile Quality
Member Company: Swift Textiles, Columbus, GA (April 91)

Title: Comparison of the Tactile Properties of Denim Fabrics Made from Ring and Rotor Spun yarns
Member Company: Cone Mills, Greensboro, NC (September 91)

Title: Relationship between Bulkiness of the Skein and that of the Corresponding Knit Fabric
Member Company: Rieter Machine Corporation, Greenville, SC (June 1992)

Title: Prediction of the Degree of Trafficking Sustained by Residential Carpets Using Compression and Surface Properties
Member Company: None (July 1982)

Title: The Effect of Differential Wet Shrinkage of Warp and Filling Yarns on the Surface Geometry and Tactile Quality of Washed Denim Fabrics
Member Company: Greenwood Mills, Lindale, GA (September 1992)

Title: Cost Benefit Analysis of 100% Wool and Wool Blended Suiting Materials Intended for Summer and Winter Suiting Applications
Member Company: Kuppenheimer, Atlanta, GA (August 1992)

Title: The Effect of Fabric Mechanical Properties on the Incidence of Puckered Seams in Garment Assembly Operations
Member Company: Dowling Textiles, Atlanta, GA (December 1992)

Title: Identification of the Fabric Low-Stress Mechanical Properties that Relate to Process Efficiency in Automated Cutting and Sewing Processes - A research project completed in collaboration with Cornell University, Ithaca, New York

Title: Evaluation of the Effects of Hand Finishing Treatments Applied on Denim Fabrics
Member Company: Group of five denim manufacturers (July 92-Aug 93)

Title: A Comparative Study of the Tactile Properties of Stone Washed Denim Fabrics Member Company: Greenwood Mills, Lindale, GA (October 93)

Title: Relationship between KES properties and the Appearance Retention Behavior of Polyester/Cotton Dress Materials
Member Company: Milliken Industries, Spartanburg, SC (February 94)

Title: Evaluation of the Tactile Quality of Washed Denim Garments Made from Schlaefhorst and Reiter yarns
Member Company: Swift Textiles, Columbus, GA (April 94)

Comparative Evaluation of a Group of Stretch-to-Fit Knit Fabrics for Blood-Flow Regulation,

Sweat Absorption, and General Wear Comfort Properties
Member Company: Marena, Inc. Lawrenceville, GA (December 1999)

Understanding the Influence of Yarn and Fabric Parameters on the Stretch Behavior of Woven Synthetic Fabrics Used in Wet-Lay Paper Making Processes, Synstrand Inc., Summerville, SC (November 1999)

Predicting the Deformation/Distortion Potential of Woven Carbon Fiber Fabrics from Measured Mechanical and Surface Properties, B. P. Amoco, Atlanta, GA (March 2000)

D. PRESENTATIONS

Invited Presentations

Parachuru, R., 'The Impact of Smart Fabric Shades and Built-in Control Strategies on Energy Savings, Building Comfort and Visual Quality', Year 2023 Smart Fabrics Summit of the Advanced Textile Association.

Parachuru, R., Material Driven Innovations in Performance Engineered High-end Fiber Products, 8th Global Webinar on Materials Science & Engineering, November 22-23, 2023.

Parachuru, R., High-end Performance Engineered Mattresses and Pillows and Their Influence on Sleep Quality, Quality of Life and Human Performance, International Conference on Technical and High-Performance Textiles, Coimbatore, India, July 2022

Parachuru, R., Materials and systems for thermal energy storage in commercial and residential buildings, Accepted for presentation in European Materials Summit, July 2024.

Parachuru R. and Vagott J., 'Smart Wearable Textiles - An Introductory Review and Highlight of Recent Lab-to-Field Successes', 4th International Conference on Industrial Textiles, July 18, 2018, Coimbatore, India. (Lead presentation in conference sponsored by govt. of India and department of defense)

Parachuru, R. Need to Develop and Validate a Set of New Test Methods for the Evaluation of the Functional Performance and Durability of Electronically Integrated Smart Textile Materials, AATCC Technical Committee Meetings, November 2018.

How to Predict the Pressure Exerted by Medical Grade Compression Garments Used in Post-Operative Healing Applications from Selected Properties of Yarns and Fabrics, International Conference on Engineered High-Performance Textiles, P. S. G. College of Technology, Coimbatore, India, July 2016.

How to Design Tests and Select Test Materials for International Proficiency Tests Intended to Revise and Update Established AATCC Test Methods, AA TCC Technical Committee Meetings, November 2014, Raleigh, NC.

Can Textile Fabrics Prevent Skin Cancer? A Look at New and Emerging Nano Materials and Their Application Techniques on Fibers to Improve the Skin Cancer Protective Performance of Clothing Materials, Invited Presentation in AA TCC Technical Committee Meetings, May 2013, Raleigh, NC.

How to Use Analysis of Variance and Design of Experiments Concepts to Optimize Product Design and Product Performance in Textile Manufacturing, AATCC Technical Committee Meetings, May 2012, Raleigh, NC.

Understanding the Influence of Yarn and Fabric Structure on the Spreading and Migration Behavior of Different Pigments (Inks) Can Improve the Quality and Performance in Ink-Jet Printing of Textiles, International Textile Conference on Emerging Technologies, P. S. G. College of Technology, July 2010, Coimbatore, India.

New Applications of Fiber-Based Products: A Review of Recent Developments, Techtextil International Conference and Exhibition, April 1-3, 2008, Atlanta, GA.

Performance Engineered High Tech Textiles: A Selective Review of Recent Advances, ITEC's World Conference on Apparel and Home Textiles, 16-18 July 2007, Coimbatore India.

Current State of Textile Education and Research in the US Universities, Curriculum Review Meeting of the International Textile Education Committee, July 13, 2007, Coimbatore, India.

A Review of Recent Advances in Synthetic Apparel Fibers, Annual Textile Conference, July 9, 2007, Chennai, India

The Use of Kawabata Evaluation System for Process and Product Optimization in Textile Manufacturing Processes, July 16, 2007, Inaugural Meeting of the Coimbatore Chapter of the Textile Association of India, July 16, 2007, Coimbatore, India.

Higher Education in the US in Polymer, Textile and Apparel Disciplines, Invited Lecture at Kumaraguru College of Technology, July 16, 2007, Coimbatore, India.

Influence of Fabric Structure on the Frictional Properties of Cotton Fabrics, Beltwide Cotton Conferences – Cotton Utilization Conference, January 9-12, 2007, New Orleans, LA.

Tactile Behavior of Fabrics Subjected to Enzyme Treatment at Yarn and Fabric Stages, 233rd National ACS Meet, Division of Cellulose and Renewable Materials, March 25-29, 2007, Chicago, IL.

Influence of Enzyme Treatment on the Tactile Properties of Woven and Knitted Fabrics Made from Ring, Rotor and Airjet Spun Yarns, AATCC International Conference, September 2005, Boston, MA.

New Ways to Achieve Functional Enhancement of Textile Products Containing Natural and Man-Made Fibers, Beltwide Cotton Conferences, January 2006, Dallas, Texas.

Applications of Nano Technology in the Textile and Allied Industries – An Overview of Emerging Trends and Some Success Stories, The Fifth Georgia Tech Conference on Nanoscience and Nanotechnology, November 10-11, 2004.

Textile Trade in the Post-Quota Regime - New Opportunities and Challenges Faced by the Manufacturers and the Suppliers, International Conference on Textile and Clothing Management (ITCM), December 13-17, 2004, Coimbatore, India.

New and Emerging Routes for the Functional Finishing of Cotton-Rich Textiles, Beltwide Cotton Conferences, January 6-9, 2005, New Orleans, LA.

Innovations in Synthetic Apparel Fibers- A Review of Recent Advances, 7th Asian Textile Research Conference, December 1-4, New Delhi, India.

Influence of Fabric Construction on the Sorption Characteristics of Apparel Fabrics, Beltwide Cotton Conferences, Jan 5-9, 2004, San Antonio, Texas (Aiguo Du is co-author)

A Comparison of the Tactile Properties of Fabrics Treated with Protease and Cellulase Enzymes, Belt-Wide Cotton Conferences, Nashville, TN, Jan 2003

Influence of Synthetic Lining Materials on the Handle, Comfort and Durability Characteristics of Assembled Garments, Belt-Wide Cotton Conferences, Nashville, TN, Jan 2003

Absorption and Softness Characteristics of Fabrics Treated with Protease and Cellulase Enzymes, ACS Conference, Charlotte, NC, September 2002 (presented by graduate student Huang Hua)

A Comparison of Skein-Based and Package-Based Yarn Enzyme Treatments, ACS Conference, New Orleans, LA, March 2003 (presented by graduate student Kasi Vijay)

Comparison of the Tactile Properties of Fabrics Representing Yarn and Fabric Stage Enzyme Treatments, ACS Conference, Charlotte, NC, September 2002 (presented by Kasi Vijay)

The Effect of Package-Based Yarn Enzyme Treatments on the Softness and Absorption Characteristics of Fabrics, Beltwide Cotton Conferences, Atlanta, GA, January 2002.

Applications of KES for Product and Process Optimization in the Nonwovens Industry, Beltwide Cotton Conferences - Nonwovens, Atlanta, GA, January 2002.

Hand Related Mechanical Behavior of Enzyme Treated Yarns Representing Different Spinning Systems, 83rd World Conference of the Textile Institute, Cairo, Egypt, March 2002.

Hand Related Mechanical Behavior of Cotton and Cotton/Polyester Yarns Subjected to Enzyme Treatment, 2nd International Conference on Biotechnology in Textiles, Athens, GA, March 2002.

New Technologies for the Design and Production of Interior Fabrics, TECHTEXTIL North America Symposium, Atlanta, GA April 2002.

Measurement and Interpretation of the Bending and Compression Properties of Spun Yarns, 14th EFS Research Forum, Raleigh, NC, August 2001.

Applications of KES for Product and Process Enhancement in the Nonwovens Industry, 11th Annual International TANDEC Conference, Knoxville, TN, November 2001.

Influence of process and machine variables on the softness of spunbonded polypropylene fabrics, Joint INDA-TAPPI Conference, Dallas, Texas, October 2000.

The interactive effects of yarn structure and treatment conditions on the hand related mechanical behavior of enzyme treated yarns, 13th Engineered Fiber Systems Conference, Raleigh, NC, November 2000.

Influence of fiber, yarn, and fabric parameters on the durability and comfort performance of cotton-dyneema fabrics, Beltwide Cotton Conferences, Anaheim, CA, January 2001.

Influence of enzyme treatment on the tactile behavior of cellulosic textile materials, 221st ACS Conference, Anaheim, CA, July 2001.

Heat and moisture transport behavior of cotton-Dykema fabrics engineered for tenting applications, Beltwide Cotton Conferences, January 2000.

Effect of enzyme treatment on the hand related mechanical properties of spun yarns, Beltwide Cotton Conferences, January 2000.

Predicting the stress-strain response of folded yarns representing different spinning systems, International Textile Research Symposium, Mount Fuji, Japan, August 1999.

Attractive new technologies for the production of industrial yarns, Annual conference of the International Industrial Fabric Manufacturers Association, March 1999.

Effect of Enzymatic Hydrolysis on the Low-Stress Mechanical Behavior and Tactile Quality of Cotton Fabrics, International Textile Research Symposium, Mount Fuji, Japan, August 1998.

Analysis and Prediction of the Structurally Linked Mechanical Behavior of Spun Yams, International Textile Research Symposium, Mount Fuji, Japan, August 1998.

Preferential Positioning of Long Staple Viscose Fibers on the Surface and in the Body of a Short Staple Cotton Yarn and its Effect on Yam and Fabric Properties, Belt-Wide Cotton Conferences, Memphis, December 1992.

Handle and Comfort Properties of Cotton/Polyester Fabrics Made from Random Blend and Cotton Covered Cotton/Polyester Yarns, Belt-Wide Cotton Conferences, New Orleans, January

1991.

Effect of Loading Conditions on the Stress-Strain Behavior of 100% Cotton and Cotton/Polyester Yarns Representing Ring, Rotor, Air-Jet and Friction Spinning Systems, foster Presentation m the Fiber Society conference, Clemson, November 1992.

Tensile Behavior of Ring, Rotor, Air-Jet and Friction Spun Yams under Non-Standard Loading Conditions, Annual Research Review Meeting Organized by Cotton Incorporated, Raleigh, February 1993.

The Relationship Between the Low-Stress Mechanical Behavior of spun Yams and the Hand quality of knit Fabrics, Belt-Wide Cotton conferences, San Diego, January, 1994.

The Low-Stress Mechanical Behavior of Cotton/Polyester yams and Fabrics Representing Differences in Fiber Distribution within the Yarn, Belt-Wide Cotton Conferences, San Diego, January 1994.

Applications of the Kawabata Evaluation System for Product and Process Optimization in the Textile and Apparel Industries, TQCA Conference, Myrtle Beach, September 1994.

Handle and Comfort Properties of Woven Fabrics Made from High Performance Fibers, International Conference of the Textile Institute on Globalization, Atlanta, September 1994.

Handle and Comfort Properties of Plain Weave Fabrics Made from High Performance Fibers, International Textile Res. Symposium, Mount Fuji, Japan, August 4-6, 1995.

Comparative Evaluation of Cotton-Covered Cotton/Polyester Yams and Denim Fabrics Representing Different Spinning Technologies, Belt-Wide Cotton Conferences, Nashville, January 1996.

Effect of Enzymatic Hydrolysis on the Low-Stress Mechanical Behavior and Hand Qualities of Woven Fabrics, Fiber Society Technical Conference, Knoxville, October 1997.

The Tensile and Rupture Behavior of Spun Yams Representing Ring, Rotor, Air-Jet and Friction Spun Yarns, Tenth EFS Conference, Raleigh, November 1997.

Effect of Enzymatic Hydrolysis on the Tactile Properties and the Appearance Quality of Woven Fabrics, Belt-Wide Cotton Conferences, San Diego, and January 1998.

E. GRANTS AND CONTRACTS

Recent Research Grants (Secured in 2020-2022)

- \$96,800 - One year CDC funded project (AWD-001549): Design, Development and Evaluation of Reusable Low-Cost, High-Performance Mask Suitable for High-Volume Use.
- \$23,700 – Six-month project sponsored by Mueller Company for developing a rapid aging test

to predict the life of painted surfaces of metal and plastic valves used in water supply lines.
 · \$7000 – One-month project sponsored by Patagonia Inc. to characterize the dynamic mechanical behavior of stretch (elastic) yarns and to relate measured properties to processing parameters.
 -\$9000 - Development of stretch-to-fit tubular knit fabrics with controlled compression behavior and favorable surface friction properties for healthcare applications

Research Proposals and Contracts/Grants Funded (PI and Co-PI Status)

Title: Understanding the Factors Governing the Functional Performance of Healing and Shapewear Garments (Industry Partner: Marena Group Inc., Lawrenceville)

PI: R. Parachuru

Sponsor: CCACTI (New project)

Amount Requested: \$65,000/year for R. Parachuru Date Submitted: 2/2009

Result: Funded: ** Funded at \$48,000 per year with consideration to increase to \$65,000 in future years.

Title: Development and Evaluation of Vapor Barrier Textiles for Energy Conservation and Environmental Control Purposes (Industry Partner: H20 Blankets, Inc., Atlanta, GA)

Sponsor: CCACTI (New project)

Amount Requested: \$50,000/year for R. Parachuru Date Submitted: 2/2008

Result: Recommended for funding but did not make the final cut. Funding committee suggested resubmission. Industry partner partial support to initiate the project.

Title: Development & Implementation of a Real Time Measurement System for Improved Quality of GA Cottons

PI: R. Parachuru

Sponsor: CCACTI (Old project)

Amount Requested: \$39,000/year for R. Parachuru Date Submitted: 2/2006

Result: Funded: ** Funded

Title: Development & Reuse of PVA Size in Towel Manufacturing Using Flash Evaporation

Co-PIs: R. Parachuru

Sponsor: CCACTI (New project)

Amount Requested: \$10,000/year for R. Parachuru Date Submitted: 2/2005

Result: Funded: ** Funded

Title: Development of Novel Continuous Coloration Processes for Difficult to Dye Processes

Co-PIs: R. Parachuru

Sponsor: CCACTI (New project)

Amount Requested: \$10,000/year for R. Parachuru Date Submitted: 2/2005

Result: Funded: ** Funded

Title: Developing a Design Oriented Fabric Comfort Model

Sponsor: National Textile Center (New project)

Leader: Dr. Yehiae El. Mogahzy (Auburn University)

Amount Requested: \$45,000/year for R. Parachuru Date Submitted: 1/01, 1/02, 1/2003
Result: Funded: ** Funding level and Period of Performance: \$ 45,000 for 12 months

Title: Analysis of Fiber-Particle-Airflow Interaction and its Application for the Development of a Novel Card-Spinning System

Sponsor: National Textile Center (Continuation project)

Leader: Youjiang Wang

Amount Requested: \$10,000/year for R. Parachuru Date Submitted: 1/2001, 2002 and 2003

Result: Funded: ** Funding level and Period of performance: \$ 10,000 for 12 months

Title: Enzymatic Preparation of Cotton

Co-PIs: Nolan Etters and R. Parachuru

Sponsor: CCACTI (Continuation project)

Amount Requested: \$39,000/year for R. Parachuru Date Submitted: 1/2001, 02 and 03

Result: Funded: ** Funded

Title: Development of Generic New Generation Carpet Construction

PI: Fred L. Cook

Sponsor: CCACTI (Continuation project)

Amount Requested: \$18,000/year for R. Parachuru Date Submitted: 1/2002, & 2003

Result: Funded: ** Funded

Title: Improved Processibility of Georgia Cottons

Co-PIs: Helen Epps, Steve Michielsen, R. Parachuru

Sponsor: CCACTI (Continuation Project)

Amount Requested: \$39,000/year for R. Parachuru Date Submitted: 1/2001,2002 and 2003

Result: Funded: ** Funded

Title: New Approaches to Improving Blend Intimacy

Sponsor: National Textile Center (New project)

P.I.: Dr. Yehiae El. Mogahzy (Auburn University)

Amount Requested: \$15,000/year Date Submitted: 1/2002

Result: Funded: ** Funding level and Period of Performance: \$ 15,000 for 12 months

Title: Understanding the Relationship Between Construction and End Use Performance of Knitted Sweat Shirts

Sponsor: Russell Corporation (New project)

Amount Requested: \$15,000/year Date Submitted: 1/2001

Result: Funded: ** Funding level and Period of performance: \$ 15,000 for 3 months

Title: Optimization of Enzymatic Dyeing and Finishing Processes

Sponsor: National Textile Center

P.I.: Dr. Gisela D. Buschle (Auburn University)

Amount Requested: \$40,000/year Date Submitted: 7/98

Result: Funded: ** Funding level and Period of Performance: \$ 18,000 for 12 months

Title: Development of New Tools and Standards for Comfort Tagging of Consumer Textiles

Sponsor: National Textile Center

P.I.: Dr. Yehiae El. Mogahzy (Auburn University)

Amount Requested: \$25,000/year Date Submitted: 7/98

Result: Funded: ** Funding level and Period of Performance: \$ 15,000 for 12 months

Title: Analysis of Fiber-Particle-Airflow Interaction and its Application for the Development of a Novel Card-Spinning System

Sponsor: National Textile Center

P.I.: Youjiang Wang

Amount Requested: \$30,000/year Date Submitted: 7/98

Result: Funded: ** Funding level and Period of performance: \$ 12,000 for 12 months

Title: Durable Finishing of Carpets: Finish Application and Evaluation

Sponsor: GenCorp Inc.

P.I.: Fred L. Cook

Amount Requested: \$18,000 Date Submitted: 9/98

Result: Funded: ** Funding level and Period of performance: \$ 18,000 for 9 months

Title: Prediction of the Shape Forming and Form Retention Behaviors of Fabrics Used in Molded Furniture Applications

Sponsor: Fabric Procurement Division of Steel Case

Co-P.I.(s): None

Amount Requested: \$25,000 Date Submitted: 10/98

Result: Funded: ** Funding level and Period of performance: \$15,000 for 6 months

Title: Source Reduction of Lubricating Oils Used on Carpet Yarns

Sponsor: CCACTI

OTHER P.I.(s): Fred L. Cook and Dr. Warren Perkins

Amount Requested: \$69,000 per year (one year only) Date Submitted: 2/98

Result: Funded: ** Funding level and Period of performance: \$65,000 for 12 months

Title: Design, Production and Evaluation of New and Innovative Denim Fabrics to Enhance the Competitiveness of Georgia's Textile Manufacturers

Sponsor: CCACTI (Consortium on Competitiveness for Apparel, Carpet and Textile Industries)

Co-P.I.(s): None

Amount Requested: \$18,000 Date Submitted: 5/95

Result: Funded: ** Funding level and Period of performance: \$18,000 (one year)

Research Proposals Not Funded (PI Status)

Title: Developing New Enabling Tools to Enhance the State-of-the-Art in Carpet Yarn Heat Setting (Industry Partner: Mohawk Industries)

Sponsor: CCACTI

Co-PIs: Walt Thomas and Helen Epps

Amount Requested: \$74,000 Date submitted: 9/94

Title: New Methods and Procedures to Predict the Creep Behavior and Dimensional Stability of Carpets (Industry Partner: Mohawk Industries)

Sponsor: CCACTI

Co-PIs: Walt Thomas and Helen Epps Date submitted: 9/94

Amount Requested: \$69,000

Title: Design and Development of a Computer-Based Decision Support System for a Modem Spinning Mill

Sponsor: National Textile Center

Co-P.I.(s): Yehiae El Mogahzy (Auburn University)

Amount Requested: \$150,000/year Date Submitted: 9/95

Title: A Modeling Approach to Understand the Compression and Bending Behavior of Core-Sheath Yarns

Sponsor: NTC

Co-P.I.(s): W. Oxenham (NCSU), B. Gowany (Clemson U.), and El Mogahzy (Auburn U.)

Amount Requested: \$200,000/year Date Submitted: 9/95 & 9/96

Title: Developing More Efficient Methods for the Measurement of Cotton Fiber Quality

Sponsor: NTC

Co-P.I.(s): El Mogahzy, A. P. S. Sawhney (USDA)

Amount Requested: \$150,000/year Date Submitted: 8/95

Title: Prediction of the Useful Life and Degradation Behavior of Textile Materials Based on KES Measurements

Sponsor: NTC

Co-P.I.(s): B. Pourdeyhimi, H. Epps (UGA)

Amount Requested: \$120,000 per year Date Submitted: 8/96

Title: An Investigation of the Fundamental Opportunities and Challenges Involved in the Electronic Imaging and Image Processing of Fiber Surfaces

Sponsor: NTC

Co-P.I.(s): B. Pourdeyhimi, J. L. Dorrity, and G. Vachtsevanos

Amount Requested: \$150,000 per year Date Submitted: 10/97

Title: Design and Development of Functionally Tailored Textile Fabrics Using Engineered Multi-Component Yarns

Sponsor: Army Research Office

Co-P.I.(s): None

Amount Requested: \$117,000 Date Submitted: 5/97

Other Proposals submitted as PI: Submitted two new proposals to CCACTI in 95, and four proposals in 96. All the proposals were in the designated “low priority areas” and so none of them received a funding recommendation.

Research Contracts/Grants (Contributor)

Title: Enzyme Treatment – Optimization of Process Parameters Based on Changes in Fabric Properties

Sponsor: NTC

Co-P.I.(s): Diller (Auburn University)

Amount Requested: \$65,000/year for GT Date Submitted: 8/96

Funded: ** Funding level and Period of performance: \$65,000 per year for 1 year

Title: Garment Chemical Processing

Sponsor: CCACTI

Co-P.I.(s): F. L. Cook, Wayne Tincher, & Nolan Etters (UGA)

Amount Requested: \$100,000 per year Date Submitted: 7/96

Funded: ** Funding level and Period of performance: \$100,000/year

Title: Functional Optimization of Containment Fabrics through Continuous Evaluation and Structural Modification

Sponsor: University of Ohio, Dayton (Corporate Sponsor: GE Heavy Equipment Division)

Co-P.I.(s): Michielson (GT-TFE), and Tom Whitney (Univ. of Ohio)

Amount Requested: \$32,000 Date Submitted: 11/97

Funded: ** Funding level and Period of performance: \$32,000

Year-wise List of Submitted Proposals

2009-10 CCACTI Proposal: Development and Evaluation of Vapor Barrier Textiles for Energy Conservation and Environmental Control Purposes (Industry Partner: H20 Blankets, Inc., Atlanta, GA)

2009-10 CCACTI Proposal: Evaluation of the Hot Nut Method of Flammability Measurement as an Alternative to the Pill (Methenamine) Test and the Radiant Panel Test (Industry Partner: Mohawk Industries, Dalton, GA)

2009-10 CCACTI Proposal: Development of Hydrophilic, Comfortable Fabrics from Hybrid Cellulosic-Nomex® Fibers (With Donggang Yao and Fred Cook)

2008-09 CCACTI Proposal: Polypropylene-Rich Wickable Towels; Design and Functional Optimization (Industry Partner: 1888 Mills, Inc., Griffin, GA)

2008-09 CCACTI Proposal: Development of Hydrophilic, Comfortable Fabrics from Hybrid Cellulosic-Nomex® Fibers (With Dong Yao and Fred Cook)

2007-08 CCACTI Proposal: Development and Implementation of a Real Time Gin-Based Measurement System for Improved Quality of Georgia Cotton (Industry Partner: Georgia Cotton Commission, Perry, GA)

2007-08 CCACTI Proposal: Developing New Enabling Tools to Enhance the State-of-the-Art in Carpet Yarn Heat Setting (Industry Partner: Mohawk Industries)

2007-08 CCACTI Proposal: New Methods and Procedures to Predict the Creep Behavior and Dimensional Stability of Carpets (Industry Partner: Mohawk Industries)

2007-08 NTC Proposal: New Generation Products with Carbon Nanotube Reinforced Fibers and Yarns (Dr. Satish Kumar was the co-principal investigator. Performance Fibers, Inc. was the industry collaborator. The proposal failed to make the first-round evaluation)

2006-07 NTC Proposal: Energy Absorbent Thermoplastic Nano-Fibrous Structures (Co-PI Status; Submitted with Yasser Gowayed of Auburn University)

2006-07 NTC Proposal: Developing an Artificial-Intelligence Model to Track Fiber Route Identity (Co-PI Status; Submitted with Yehia El Mogahzy of Auburn University)

2005-06 NTC Proposal: A Modeling Approach to Understand the Web-Forming and Handling Behavior of Staple Fibers

2005-06 CCACTI Proposal: Development and Promotion of Cotton-Rich Nonwoven Fabrics Through Melt-Blowing and Spun-Bonding Processes

2005-06 CCACTI Proposal: Defining the Degree of Set of Heat Set Carpet Yarns Through Compression and Bending Energy Measurements

2005-06 CCACTI Proposal: New Methods and Procedures to Predict the Creep Behavior and Dimensional Stability of Carpets

2004-05 NTC Proposal: A New Approach to Product Evaluation Focusing on End-use Based Product Appraisal

2004-05 CCACTI Proposal: Evaluation of the Economic Benefits and Process Improvements of a Novel Yarn Conditioning Process

2004-05 CCACTI Proposal: Functionally Enhanced Yarns and Fabrics Through Cost Effective Enzymatic Yarn Package Treatments

2004-05 GT-CDC Joint Research Proposal: Development and Evaluation of Novel Nonwoven Masks and Filters with Durable and Refreshable Antimicrobial Properties

2004-05 CCACTI Proposal: Development of a Pneumatic Shedding Device to Enhance Weaving Performance (Youjiang Wang is the PI)

2004-05 CCACTI Proposal: Development of Generic Next Generation Carpet Construction (Fred L. Cook is the PI)

2004-05 CCACTI Proposal: Development of Novel Continuous Coloration Processes for Difficult-to-Dye Fibers (Fred L. Cook is the PI)

2004-05 CCACTI Proposal: Recovery and Re-Use of PVA Size in Towel Manufacturing Using Flash Evaporation (Fred L. Cook is PI)

2004-05 CCACTI Proposal: Development and Implementation of a Real Time Measurement System for Improved Quality of Georgia Cotton

2003- 04 NTC Proposal: Understanding the Web-Forming and Handling Behavior of Staple Fibers

2003-04 NTC Proposal: Development and Promotion of New Cotton-Based Unconventional Textile Products

2003-04 CCACTI Proposal: Creating Surface Designs on Carpets and Textile Fabrics Using Laser Beams

2003-04 CCACTI Proposal: Application of Permanent Antimicrobial Finishes on Carpets Using Plasma Technologies

2003-04 CCACTI Proposal: An Economically Viable and Environmentally Friendly Enzyme Process for the Preparation of Wool

2002-03 NTC proposal: A New Approach to Specifying Textile Quality (Received A-grade for scientific content. It was also rated #1 project in the school in the information category.

2002-03 NTC Proposal: Understanding and Optimizing Noise Absorption Characteristics of Textile Structures

2002- 03 CCACTI Proposal: Development of Generic Next Generation Carpet Construction (Fred L. Cook is the PI)

202-03 NTC Proposal: Environmentally Benign Closed-Loop Preparation Process (Gisela B. Diller is the PI)

202-03 NTC Proposal: Biomimicking of Enzymes for Textile Wet Processing (Gisela B. Diller is the PI)

2002-03 Proposal to Federal Agency: Application of Laser Beams to Develop Design Patterns on Unfinished Textile Fabrics

2001- 02 CCACTI Proposal: Development of Innovative, Environment Friendly Yarn Finishing Processes to Enhance the Functional Performance of Cotton-Rich Fabrics (committee suggested merger with UGA proposal and recommended funding)

2001- 02 CCACTI Proposal: Development of Novel Methods and Procedures to Predict the Dimensional Stability of Finished Carpets

2001-02 CCACTI Proposal: Improved Processability of Georgia Cottons (with Steve Michielsen - committee suggested merger with UGA proposal and recommended funding)

2001-02 NTC Proposal: New Approaches to Improving Blend Intimacy (with El Mogahzy)

2001-02 NTC Proposal: Understanding and Defining the Dynamic Behavior of Fibers Suspended in Running Water Streams

2001-02 NTC Project: Fundamental Investigation of the Bagging Phenomenon in Knitted Fabrics (with Nuray Ucar and Mary Lynn Realff)

2001-02 Industry Proposal: Improving the Hold and Stability of Yarn Loops Tufted into Nonwoven Backings (Submitted to Colbond Nonwovens)

2001-02 Industry Proposal: Understanding the Relationship Between Construction and End Use Performance of Knitted Sweat Shirts (approved for funding by Russell Corporation)

1999-2000 SBIR PROPOSAL: Engineered Stretch-to-Fit Fabrics to Promote Healing and Comfort in Post-Operative Care Garments.

The industry partner, Marena Group Inc., decided based on the discussions it had with the research program administrators of SBIR that it is unable to meet the SBIR obligations until the Year 2003.

F. SOCIETAL AND POLICY IMPACTS

Served as expert witness in two dozen litigations arising in different parts of the country. I provided these services to federal, state and local governments and private enterprises located in different states. Expert testimony services provided for the state of Georgia include three different murder cases that involved fiber evidence as one of the primary sources of evidence. My testimony in one of the murder cases was briefly discussed by one of the local TV channels in their 6:30 PM evening news. Services provided to the federal government include deposition and testimony services which were based on product deconstruction and evaluation. My testimony helped to successfully defend the import duties levied by the Department of Commerce on a range of protective garments, including protective motor cycle apparel.

V. TEACHING

A. COURSES TAUGHT

<u>Quarter</u>	<u>Course</u>	<u>No. of Students</u>
Fall 92	TEX3I1O	18
Spring 92	TEX 2103	36

Winter 93	TEX 3103	12
Fall 93	TEX 4420/6101	30
Summer 93	TEX 3118	16
Winter 94	TEX 311O	11
Fall 94	TEX 3118	24
Spring 94	TEX 31O3 16	
Winter 95	TEX 31O3	14
Winter 95	TEX 4420/6lOl	25
Spring 95	TEX 3118	19
Fall 95	TEX 4491	8
Winter 95	TEX 4491	10
Spring 95	TEX 4491	9
Fall 95	TEX 31O3	22
Spring 96	TEX 311O	30
Fall 96	TEX 31O3	14
Winter 96	TEX 3118	18
Fall 96	TEX 4491	7
Spring 96	TEX 4491	10
Winter 97	TEX 311O	13
Spring 97	TEX 3118	26
Fall 97	TEX 442O/6lOl (Theory and Lab)	15
Fall 97	TEX 4491	10
Winter 98	TEX 3103	9
Winter 98	TEX 4491	5
Winter 98	TEX 4420/6101 (theory and Lab)	15
Spring 98	TEX 3110	14
Spring 98	TEX 4491	11
Fall 98	Tex 3103	10
Fall 98	TEX 4491	5
Winter 99	TEX 3110	7
Spring 99	TEX 3118	7
Spring 99	TEX 4491	3
Spring 99	TFE 4815 (with Youjiang Wang)	14
Fall 99	TFE 3090	9
Winter 2000	TFE 4091	10
Winter 2000	TFE 2100	10
Summer 2000	TFE 1100	4

Played a lead role in developing the semester versions of graduate and undergraduate courses in the area of dry processing

Fall 2000	TFE 4091	8
Fall 2000	TFE 4002 testing lectures only	15
Fall 2000	TFE 4093 lab	15
Fall 2000	TFE 3090 (with Walt)	8
Spring 2001	TFE 4091	8
Spring 2001	TFE 3090 (with Walt)	9
Fall 2001	TFE 4091	7
Fall 2001	TFE 4002 testing lectures only	14
Fall 2001	TFE 3090 (with Walt)	12
Winter 2001	TFE 4091	1 (graduating senior)
Winter 2001	TFE 3090 (with Walt)	12
Spring 2002	TFE 3090 (with Walt)	13
Fall 2002	PTFE 3200	10
Spring 2003	PTFE 3200	12
Fall 2003	PTFE 2200 (with Kumar)	15
Spring 2004	PTFE 3221 (with Walt)	14
Fall 2004	PTFE 2200 (With Wang & Griffin)	18
Spring 2005	PTFE 2200 (With Wang & Griffin)	14
Spring 2005	PTFE 3221(With Thomas)	12
Fall 2005	PTFE 2200 (With Wang & Griffin)	16
Spring 2006	PTFE 3221 (With Thomas)	8
Spring 2006	PTFE 3200	31
Spring 2006	PTFE 2200 (With Vivek Sharma)	26
Fall 2006	PTFE 2200 (with Wang and Griffin)	19
Fall 2006	PTFE 3221(with Thomas)	4
Spring 2007	PTFE 2200 (with Bucknall and Theo)	23
Spring 2007	PTFE 3200	10
Spring 2007	PTFE 3221	1
Fall 2007	PTFE 2200 (with Wang and Griffin)	17
Spring 2008	PTFE 2200 (with Wang and Griffin)	34
Spring 2008	PTFE 3221 (with Walt Thomas)	4
Fall 2008	PTFE 2200 (with Wang & Griffin)	18

Spring 2009	PTFE 2200 (with Wang & Griffin)	29
Spring 2009	PTFE 3221	1
Fall 2009	PTFE 2200 (with Wang & Griffin)	24
Spring 2010	PTFE 2200 (with Wang & Griffin)	29
Spring 2010	PTFE 3221	7
Fall 2010	PTFE 2200 (with Wang & Griffin)	15
Fall 2010	MSE3021	38
Spring 2011	PTFE 2200 (with Wang & Griffin)	29
Spring 2011	PTFE 3221	8
Spring 2011	MSE 4022	38
Fall 2011	PTFE 2200 (with Wang & Griffin)	15
Fall 2011	MSE 3021	40
Spring 2012	PTFE 2200 (with Wang & Griffin)	19
Spring 2012	PTFE 3221	6
Spring 2012	MSE 4022	42
Fall 2012	PTFE 2200 (with Wang & Griffin)	15
Fall 2012	MSE 3021 (Materials Laboratory-I)	46
Spring 2013	MSE 4022 (Materials laboratory-II)	54
Fall 2013	MSE 3021 (Materials Laboratory-I)	56
Spring 2014	MSE 4022 (Materials laboratory-II)	54
Fall 2014	MSE 3021 (Materials Laboratory-I)	56
Summer 2014	Phil 6000 Research Ethics	42
Spring 2015	MSE 4022 (Materials laboratory-II)	62
Fall 2015	MSE 3021 (Materials Laboratory-I)	70
Spring 2016	MSE 4022 (Materials laboratory-II)	80
Fall 2016	MSE 3021 (Materials Laboratory-I)	86
Spring 2017	MSE 3021 (Materials Laboratory-I)	85
Spring 2017	MSE 3720 (Intro Poly & Fiber Enter)	29
Summer 2017	MSE 2001 (Prinps & Appls of Engg Matls)	22
Fall 2018	MSE 4025 (Fiber Product Manufacturing)	10
Fall 2018	MSE 4022 (Materials Laboratory-II)	85
Spring 2018	MSE 3021 (Materials Laboratory-I)	87
Spring 2019	MSE 3720 (Intro Poly & Fiber Enter)	53
Summer 2019	MSE 2001 (Prinps & Appls of Engg Matls)	23
Fall 2019	MSE 4025 (Fiber Product Manufacturing)	14

Spring 2020	MSE 3720 (Intro Poly & Fiber Enter)	39
Fall 2020	MSE 4025 (Fiber Product Manufacturing)	12
Spring 2021	MSE 3720 (Intro Poly & Fiber Enter)	35
Summer 2021	MSE 2001 (Prinpls & Appls of Engg Matls)	24
Fall 2021	MSE 4025 (Fiber Product Manufacturing)	10
Spring 2022	MSE 2001 (Prinpls & Appls of Engg Matls)	30

B. INDIVIDUAL STUDENT GUIDANCE

Ph.D. Students – Georgia Tech

I served as the chairman of the advisory committee of Shamal Mhetre who obtained his Ph.D. in the year 2010 for his thesis work on ‘Fluid Distribution in Textile Structures’. After completing his Ph. D., he started working with me as a Post-Doctoral Research Associate and worked in this capacity for 10 months.

I served as Ph. D. committee chair of Huang Hua. After successfully completing her Ph. D. qualifying examinations and successfully defending her Ph. D. thesis proposal on “Frictional Properties of Woven Fabrics,” she managed to secure a suitable job with promise for green card sponsorship. She took leave of absence for 4 years and failed to return to get her Ph. D. degree.

I served as Ph. D. committee chair of Gan Huang who worked with me for his M.S. thesis. He successfully defended his Ph.D. thesis proposal on, “Understanding the Structurally Linked Mechanical Behavior of Ring, Rotor, Air-Jet and Friction Spun Yarns.” Approximately six months prior to thesis submission, he used his MS in computer science to obtain a CS job. Having started his green card process, he preferred to stay with the company and failed to comeback to get his Ph.D.

I served as co-chairman on the Ph. D. committee of Aiguo Du who discontinued after spending 11 months on the program when her husband (a Ph.D. graduate of GT) took up a job in California.

M.S. Students – Georgia Tech (Roll as Committee Chair)

Kasi Vijay graduated in December 2003. His thesis work focused on defining the differences in the mechanical behavior and tactile qualities of enzyme treated spun yarns representing differences in internal structure and fiber composition.

Jingwu He graduated in Summer 2000. The title of his thesis was, ‘Study of the Interactive Effects of Yarn Structure and Enzyme Treatment Conditions on the Hand Related Mechanical Behavior of Spun Yarns’.

Xiaomin Meng graduated in Summer 2000. The title of her thesis was, ‘Effect of Yarn and Fabric Structural Parameters on the Performance of Cotton/Dyneema Fabrics for Tenting

Applications.'

Gan Huang graduated in 1994. His thesis title was, "Handle and Comfort Properties of Woven Fabrics Made from High Performance Fibers."

M.S. Students - North Carolina State University

Advisee: Jeong Sung Hoon

Title of thesis: A Comparative Study of the Hand, Comfort and Durability Characteristics of Apparel Fabrics Containing Woven and Nonwoven Interlinings in Fused and Sewn States of Assembly (1987).

Role: Co-advisor and Committee Member

M.S. Students - University of Madras, India (Roll as Committee Chair)

Title of Thesis: Study of the Structure, Properties and Spinning Performance of Polypropylene and Polypropylene Blended Rotor-Spun Yarns (1985)

Advisee: P. Udayakumar

Title of Thesis: Design and Fabrication of a Pedal Operated Single Head, Self-Pumping Type Rotor Spinning Machine for Application in the Home Spinning Sector (this work was carried out in collaboration with an industry partner and the model developed has already been adopted for manufacture by a private engineering firm; the work also received recognition as the best graduate project of the year) - 1984

Advisee: R. Ayyaswamy

Title of Thesis: Study and Evaluation of Different Spin Finishes for Rotor and Friction Spinning Applications (1984)

Advisee: S. Mariappan

Title of Thesis: Influence of Spinning Process Parameters on the Wet Contraction Behavior of Yarns and Fabrics (1982)

Advisee: M. Malliyah

Title of Thesis: Study of the Performance Characteristics of Woven Fabrics Produced from Doubled Ring and Rotor Yarns of Varying Twist Densities (1982)

Advisee: S. Kumaravel

Title of Thesis: Effect of Spinning Process Variables on the Structure and Properties of 100% Acrylic and Acrylic Blended Rotor-Spun Yarns (1982)

Advisee: P. Sundararajan

Title of Thesis: A Comparative Study of the Performance of Selected Makes of Modern High Speed Draw Frames (1981)

Advisee: R. Manoharan

Title of Thesis: Structure and Properties of Special Cotton Yarns Containing Filaments of Different Extensibilities in Preferred Positions Within the Yarn Cross Section (1981)

Advisee: S. P. Shekar

Title of Thesis: Effect of Using Small Percentages of Long Staple Viscose Fiber on the Surface and in the Body of a Short Staple Cotton Yarn (1981)

Advisee: B. Arulselvan

Undergraduate Projects - Georgia Institute of Technology

Title: The Influence of Yarn and Fabric Structure Variables on the Dry and Wet Airpermeability Characteristics of Cotton/Dyneema Fabrics

Advisee: Shaun Bellami (Fall 1999)

The Influence of Fiber Denier and Cross-Sectional Shape Variables on the Tactile Characteristics of Polyester/Wool Fabrics

Advisee: Matthew Jenkins (Summer 1999)

Evaluation of the Degree of Sensitivity of the Measured Hand Values to Different Fabric Mechanical Properties

Stephanie Patterson (Fall 1999)

A Review of the Recent Developments in the Carding Process

Advisee: Laura Parker (Fall 1999)

The Tensile and Frictional Properties of Carpet Yarns Before and After the Removal of Fiber/Spin Finish

Advisee: Megan Whittaker (Spring 1999)

Attribution of Fabric Defects to Loom Design Parameters Based on a Statistical Analysis of Defect Occurrences

Advisee: Ahmed Khalifa (Summer 1999)

Title: Understanding the Role of Yarn and Fabric Structures on the Compressive Squeeze Behavior of Skin Tight Garments

Advisee: David Elwell (Spring 1999)

Title: A Critical Review of the Recent Developments in the Design, Production and Evaluation of Bullet-Proof Vests

Advisee: Melanie Wilson (Spring 1999)

Title: Influence of Yarn Flexural Rigidity and Lateral Compression Properties on the Softness and Appearance Properties of Carpets

Advisee: Megan Whittaker (Spring 1999)

Title: Understanding the Role of Yarn and Fabric Structures on the Compressive Squeeze Behavior of Skin Tight Garments

Advisee: Ropekia Gunn (Winter 1999)

Title: A Critical Review of the Recently Proposed Carding Theories

Advisee: Melanie Wilson (Fall 1998)

Institution: Georgia Institute of Technology

Title: Influence of Fiber Type and the Level of Lubrication on the Surface Frictional Properties of Carpet Yarns

Advisee: William Harton (Fall 1998)

Title: Study of the Stiffness of Enzyme Treated Fabrics as a Function of Weight Loss

Advisee: Justin Jones (March 1998)

Title: Prediction of the Wear Life of Nylon Panty Hose Materials Using Tensile and Shear Fatigue Properties

Advisee: Ko Ying-Joe (March 1998)

Title: Study of the Softness of Enzyme Treated Fabrics as a Function of Weight Loss

Advisee: Stacy Jeans (March 1998)

Title: The Relationship between Treatment Conditions and the Changes in Thermal Properties of Enzyme Treated Fabrics

Advisee: Justin Jones (December 1997)

Title: Study of Softness and Thermal Properties as a Function of Fabric Weight and Construction

Advisee: Chris Corner (December 1997)

Title: Study of the Distribution of Hairs in Poly/Cotton Yarns Produced on Different Spinning

Systems

Advisee: T. Wayne Neal (May 1996)

Title: Computation of a Correction Factor for the Denier Measurement of Non-Circular Fibers

Using the Vibrating Strings Principle

Advisee: Catherine Keller (May 1996)

Title: Design of New Test Methods for the Evaluation of the Durability of Synthetic Floor Tiles

Advisee: Tim Davis (January 1996)

Institution: Georgia Institute of Technology

Title: Design of New Test Methods for the Evaluation of the Appearance Quality of Synthetic

Floor Tiles

Advisee: Gretchen Bleistine (May 1996)

Title: Stress-Strain Behavior of Sized Poly/Cotton Yarns Processed on Open-end and Ring

Spinning Systems

Advisee: Karen Copeland (December 1995)

Title: The Application of Ruti Web Tester to Assess the Linting Potential and Abrasion

Resistance of Unsized Staple Fiber Yarns

Advisee: Tu Vu (August 1995)

Title: Study of the Long and Short-Term Mass Variations and Their Association

With the Strength Variation of Tandem Spun Yarn
Advisee: Thanh Khanh Tran (June 1995)

Title: The Association between the Cover Factor and the Low-Stress Mechanical Behavior of Plain and Twill Weave Fabrics
Advisee: Kenneth Rooks (March 1995)

Title: Design of a Cantilever Type Bending Tester to Measure the Bending Rigidity of Staple Fiber yarns and its Application to Measure the Bending Rigidities of Staple Yarns Processed on Different Spinning Systems
Advisee: Stan W. Smith (March 1995)

Title: Effect of Loop Length on the Mechanical Properties and the Tactile Behavior of Jersey Fabrics
Advisee: C.V. Hamilton (March 1995)

Title: The Association between the Level of Modernization and Profitability of Textile Mills
Advisee: Mark E. Beatty (March 1995)

Title: Comparative Evaluation of the Structure and Properties of Cotton Covered Core-Sheath Yarns Produced on Ring, Rotor, Air-jet and Friction Spinning Systems (1994)
Advisee: Jim Rose

Title: Investigation of the Relationship Between the Compression Properties and Subjectively Evaluated Comfort Performance of Assembled carpets (1994)
Advisee: Peter Tran

Title: Structural Modification of the Rotor Yarn to Minimize Linting in Terry Towel Applications (1994)
Advisee: Jeffrey Stewart

Title: Study of the Relationships among Tear Strength Values Obtained from Four Different Test Methods (1993)
Advisee: Stanley Smith

Title: Analysis and Comparison of Fabric Bending Measurements Made on Instron, Shirley Cantilever Tester, and KES Bending Tester
Advisee: Charlie Simmons
Institution: Georgia Institute of Technology (1993)

Undergraduate Projects - University of Madras, India

Title: A Comparative Study of the Quality and Process Performance of Rotor Yams Produced from Washed Unwashed and Mercerized Flat Strips
Students: G. Venkatachalapathy and R. Rengasamy (1984-85)

Title: Study of the Length Distribution of Flat Strips Occurring in the Heel and Toe Portions of the Flat

Students: R. Sripathy and T. Selvaraj (1984-85)

Title: Study of the Relative Moisture Conditioning Behavior of Different Cotton Varieties

Students: K. Arivarasu M. Kathirvel and S. kumar (1983-84)

Title: Drawing on Pneumatic Draw Frames .Influence of Process Variables on Fiber Rupture and Sliver Uniformity

Students: V. P. Venkateswaran and E. Velumani (1982-83)

Title: Study of the Influence of Carding and Spinning Process Variables on the Quality of Viscose Yams Produced from Long Staple (60 mm) Fibers

Students: P. Sivanandan, D. B. Sundaram and M. Kannan (1981-82)

VI. SERVICE

PROFESSIONAL CONTRIBUTIONS

Senior Member of Fiber Society (Since 1990)

Senior Member of Textile Quality Control Association – Elected Leadership Role (2001-2009)

Senior Member of AATCC – Chairman of Statistics Committee since 2008; Voting/Review Member of Several Committees, Including Materials Committee & New Test Methods Committee

Life Member of the Textile Association of India

Life Member of the Institution of Engineers, India

Has been serving as ‘Research Reviewer’ for the ‘Textile Research Journal’ for the past 20 years

Has been serving as ‘Research Reviewer’ for the ‘J. Test. Institute’ for the past 15 years

Invited Speaker of Many International Conferences

Key Note Speaker of Four International Conferences

Chaired Conference Sessions in Nine National/International Conferences

Approved Ph.D. Examiner of Four Nationally Ranked Universities of India.

EXPERTISE IN STATISTICS AND ADVANCED DATA ANALYSIS

Extensive exposure to Minitab and SAS statistical packages and EXCEL data analysis tools; Expertise in using experimental design, data visualization, data programming and charting tools; Analysis of univariate and multivariate data sets for business and research purposes using statistical tools such as multiple regression, cluster analysis, factor analysis, PCA, etc.; Knowledge of Tableau, Python, SQL and R; Critical thinking skills; Preparation and presentation of effective data analysis reports to decision makers.

EXPERT TESTIMONY SERVICES

Served as a field expert in more than 48 litigations (court cases) involving fiber/polymer/textile products and their manufacturing technologies. Presented expert testimony in federal, state, and county courts in eight different states. Helped to solve four murder cases that involved fiber evidence for conviction/release. Also helped to solve three rape accusations based on fiber transfer evidence.

COORDINATION OF PUBLIC SERVICE ACTIVITIES SINCE 1992

I served as the coordinator of the school's public service activities for PFE and PTFE schools. I continue to serve as the coordinator of the public service activities of MSE. A few examples of my unique and note-worthy accomplishments in this role are:

1. Support for the promotion of an internationally recognized post-operative healing garment manufacturer in Metro-Atlanta

Marena Group Inc. of Lawrenceville, GA was started by a married couple in the basement of their home in 1993. They started an ambitious project of producing and distributing medical grade compression garments for post-operative healing applications. Their only background in textiles was the experience of one of them as a seamster in an apparel company. For the success of this project, they depended heavily on the textile expertise available at Georgia Tech. I have associated with them from day 1, as per the suggestion of the then school chair, prof. Fred L. Cook. I continue to help them even today after they grew into a multi-million-dollar company that exports healing garments to plastic surgeons and their customers in 54 different countries. Over the years, I helped them to:

Optimize the properties of the stretch yarn that is used to produce the lock knit fabric.
 Optimize the structure of the lock knot fabric
 Optimize the design of the fabric for absorption, quick drying & anti-bacterial properties
 Optimize the fabric design for tactile and thermal comfort properties
 Helped to come up with equations to predict compressive pressure from yarn, fabric and garment properties.

The work I did for them helped them to become an internationally sought after medical garment manufacturer.

When the couple decided to go for a divorce in the year 2012, the factory was left to the custody of the wife who had no college education. Dr. Shamal Mhetre who obtained his Ph. D. working with me on some of the Marena projects, joined the company and helped it to stabilize.

2. Helping a California based consulting company (RAST Associates, Inc.) to develop a stretch fabric with 200% stretch and instantaneous near complete recovery after thousands of stretch cycles, for application in keyboards and cell phones. This development was commercialized with modifications.
3. Helping Packard Industries of Georgia to develop and optimize methods for dry (water less) application of color on nylon, polyester and polypropylene rug yarns

4. Helping the US Department of Commerce to successfully fight a legal case involving millions of dollars of revenue from imported protective garments, including motor cycle jackets and pants

INSTITUTE CONTRIBUTIONS

Served on the area committees of Chuck Carr and Youjiang Wang for faculty promotions

ASSET Coordinator - 1994

Member of the UG Admissions Evaluation Committee -97

Member of the Ph.D. Qualifying Examinations Committee, PTFE

PROFESSIONAL DEVELOPMENT

Completed 80 credit hours of non-thesis course work to obtain an MS degree in Decision Sciences from Georgia State University

Participated in several GT arranged live telecasts on distance learning and high-tech classrooms.

Participated in about 60% of the teaching improvement seminars conducted by CETL on Thursdays between 11:00 and 1:00 during 1992-96.

Enrolled in the 98-99 GT Mentorship Program under the mentorship of John Maguire, Business Development Manager, GTRI. Participated in the monthly mentorship meetings held at GTRI and met with the mentor on several occasions for advice on proposal preparation. I am currently preparing the following two proposals under the active supervision of the mentor.

Participated in several self-development and leadership courses offered by Georgia Tech

EXHIBIT B

LIST OF COURT CASES ATTENDED IN RECENT YEARS

CASE 1: Leman's Corp (Plaintiff) Vs United States (Defendants). The case focused on disputed import duty structure for protective motor cycle apparel imported from Asia - Worked for Defendants (US Department of Commerce).

Attorney: Alexander Vanderweide; Civil Division Trial Attorney, US Dept. of Justice

****CASE 2:** State of Georgia (Plaintiff) Vs Noberto Mojica (Defendant). This is a criminal case which involved fiber evidence (use of fiber-based rope and fiber shedding garments to commit murder) – Worked for Plaintiff

Attorney: Jenny Lubinsky; State Attorney, State of Georgia

***CASE 3:** US Air Force (Plaintiff) Vs Derm Buro Inc. (Defendant). The case involved the failure during use of an anti-gravity suit worn by fighter plane pilots – Worked for Defendant

Attorney: Deposition or court room testimony was not needed for this case because it was settled outside the court room. Worked mainly to analyze the product and gather performance data of the product.

***CASE 4:** Outside the Box Innovations (Plaintiff) Vs The Rooster Group (Defendants). The case dealt with patent violation claims on the design of soft tool bags –Worked for the Defendant

Attorneys: Joel Myers; Myers & Kaplan Intellectual Property Law, P. C.

CASE 5: Jamie Bouchard (Plaintiff) Vs Outer Space Sports (Defendant) – Worked for the Plaintiff. The case argued about the improper design of a protective motor cycle jacket. The argument was that the jacket melted under frictional drag forces, causing third degree burn injuries to the wearer

Attorney: Tom Holbird; Tom Holbird, P. C.

CASE 6: R. C. Fabric Inc. (Plaintiff) Vs Hip and Hip Inc. (Defendant) – Worked for Plaintiff. This case argued that the actual specifications of certain imported sports-wear apparel did not confirm to the originally agreed to set of specifications.

Attorney: Stephen Truppe; SBC Global, Inc.

***CASE 7:** Slaughter (Plaintiff) Vs Ford Motor Company (Defendant) – This case focused on the alleged short-comings in the seat-belt design which caused death/severe injury to the passengers -Worked for Plaintiff

Attorneys: Warshauer; Warshauer, Thomas, Thornton and Rogers, P. C.

****CASE 8:** State of Georgia (Plaintiff) Vs Dale McKenzie (Defendant) --This case involved fiber evidence in support of a murder accusation. Worked for the plaintiff

Attorney: Ed Vaughn; State Attorney, State of Georgia

***CASE 9:** Geladon (Plaintiff) Vs Tube Tex Inc. (Defendant). This case focused on the alleged inadequacy of the safety features of patented manufacturing equipment that are expected to prevent injuries to the operators. Worked for plaintiff
Attorneys: Ronald Rodman; Friedman, Rodman and Frank P. A.

CASE 10: Angela Johnson (Plaintiff) Vs Jiffy Lube (Defendant). This case was concerned with the personal injury to the plaintiff caused by a slick surface. Worked for the plaintiff. Attorneys: Cash, Krugler & Fredericks, Atlanta, GA 30342. I was not involved in testimony or deposition. My role was limited to producing a test report after testing the oil stained clothing.

CASE 11: Clayton Miller (Plaintiff) Vs Universal fibers (Defendant). This case argued that the quality of the yarn supplied by the defendant differed from what was agreed to in the mutually accepted contract. Worked for the plaintiff. The dispute settled out of court.

Attorneys: Coppedge & Evans, P. C., Dalton, GA 30720

Attorney: Coppedge, Jr.

Coppedge & Associates, P.C.

508 South Thornton Avenue

Dalton, GA 30720

Telephone: 706/226-0040

Facsimile: 706/226-0050

CASE 12: Walden (Plaintiff) Vs Children's Apparel, Inc. (Defendant). This case is a product liability suit related to fire safety of flame retardant treated clothing. Worked for the plaintiff. Case was settled outside the court room

Attorney: David E. High, Esq.

High Law Office PLLC

300 James Robertson Parkway

Court Square Building, 2nd Floor

Nashville, TN 37201

(615)256-1000

(615)256-1009 Fax

****CASE 13.**

Attorney: J. Wrix McIlvaine

McILVAINE LAW GROUP

901 G Street

Brunswick, Georgia 31520

Tel: (912) 275-8014

Fax: (912) 275-8027

jwm@mcilvainelawgroup.com

www.mcilvainelawgroup.com

DOFS Case # 2012-6006149

My participation involved independent analysis of fiber evidence and flame retardancy and providing testimony in Camden County court located in Woodbine, GA.

Case 14.

Attorney: Sofia Jeong

Troutman Sanders LLP

600 Peachtree St. NE, Ste. 5200

Atlanta, GA 30308, USA

Direct: 404-885-3678 | Fax: 404-962-6596

sofia.jeong@troutmansanders.com

Service Provided: Expert opinion on the classification of polyacrylate fiber. Analyzed the monomers and polymerization reaction to assess the composition of acrylonitrile groups in the fiber. Based on this analysis, I concluded that polyacrylate fiber cannot be classified in the category of “modacrylic” fibers.

Case 15.

Attorneys: Cynthia Lee and Eric Mauer

Thomas Horstmeyer Intellectual Property Attorneys

400 Interstate North Parkway SE

Suite 1500

Atlanta, Georgia 30339-5029

Phone: (770) 933-9500

Fax: (770) 951-0933

thomashorstmeyer.com

Dispute: Alleged patent violation involving the design of cooling towels— Provided expert services on behalf of Grabber, Inc, defendants in a patent related dispute involving cooling towels with a brushed soft surface. The towels were marketed to athletes participating in competitive sports events as comfort products.

CASE 16:

Sheppard, Mullin, Richter & Hampton, LLP

Attorney: Robert Guites (Partner)

SAN FRANCISCO

Four Embarcadero Center

Seventeenth Floor

San Francisco, CA 94111

Tel: 415.434.9100

Fax: 415.434.3947

Through IMS Expert Services, New York (www.ims-expertservices.com)

Litigation: Cascade Yarns (Defendant) Vs Knitting Fever (Plaintiff). Worked for the plaintiff

Dispute: Country of origin of hand knit yarns- Branded yarns that were marked as made in Spain and Italy are disputed as Chinese made yarns.

CASE 17:

Coppedge & Evans, P. C., Dalton, GA 30720

Attorney: Coppedge, Jr.
Coppedge & Associates, P.C.
508 South Thornton Avenue
Dalton, GA 30720
Telephone: 706/226-0040
Facsimile: 706/226-0050
Worked for Plaintiff, Tai Pings Carpet
Dispute involved time bound variations in the quality and performance of cushioned backing materials manufactured under three different brand names using three different material compositions. I have analyzed the composition and certain performance characteristics of backing materials produced at different intervals.

CASE 18:

MBN Law, Inc.
William F. Jourdain, Attorney
745 College Drive
P.O. Box 2586
Dalton, GA 30722-2586
Phone: (706) 259-2586

The case focused on alleged violation of trade secrets associated with certain manufacturing technologies for rubber backed floor mats. I have assisted the defendant who was represented by MBN Law, Inc.

***CASE 19:**

Valdez Law Group, Inc.
Karen J. Evans, Attorney
Oakland, CA 94612
Phone: (415) 202-5949

The case involved a dispute between an apparel supplier located in California and an apparel manufacturer located in one of the South American countries. The apparel supplier claimed compensation from the apparel manufacturer based on certain defects found in the finished apparel. The apparel manufacturer argued that the defects were present in the original fabric supplied by the apparel distributor. I have provided expert testimony in the case in front of an arbitration panel

***CASE 20:**

Carroll McNulty & Kull
Matthew J. Lodge / Joshua Wirtshfater
New Jersey, NJ 07920
908-848-6300

The case involved damage claims on several hundred fabric rolls stored in a warehouse which also housed other materials, including some fabric processing equipment. I assisted the law firm which represented the insurance company. I have analyzed the construction of fabrics taken from a randomly picked set of rolls and estimated the dollar value of the fabric contained in each

role. I also determined if there is any significant damage to the surface layers of the fabric contained by each roll.

***CASE 21:**

Bryan Cave, LLP

Alexander Walden / Frank Fabiani

New York, NY 10104

212-541-2000

The case involved alleged patent infringement claims and counter claims for patent invalidation through *Inter Partes* review procedure. I have assisted the attorneys who represented the patent owners for performance pillows, engineered pillow covers and high performance mattresses.

****CASE 22:**

Hayden Willis Law, LLC

Hayden Willis

Moultrie, GA 31768

229-668-0379

The parties involved in this case were the state of Georgia and an individual who has been accused of murder and theft. The case involved fiber evidence which was presented by the state as possible support for the accusation. I have assisted the defense attorneys who represented the individual who has been accused of the above charges.

CASE 23:

Sheppard Mullin

Sheppard Mullin Richter & Hampton LLP

12275 El Camino Real, Suite 200

San Diego, CA 92130-2006

858.720.8900 | main

www.sheppardmullin.com

This case was focused on alleged violation of a patented design for a warp knit fabric. I have assisted the defendants to prove that there is no patent violation involved.

CASE 24:

Renner Otto

1621 Euclid Avenue, Floor 19

Cleveland, OH 44115 U.S.A.

216.621.1113

This case related to the design of a limb encircling therapeutic compression device (a textile structure used for healing and therapeutic purposes). I have assisted the law firm which represented the defendants.

CASE 25:

James Robson

Pinkerton & Laws of Georgia Inc.

1165 Northeast Pkwy

Marietta, GA 30067
770-956-9000

This case was a civil action suit arising from a personal injury to an individual. I represented the plaintiff.

***CASE 26:**

Abraham Feinstein Hillsman
McGuinn, Hillsman & Palefsky LLP
535 Pacific Ave
San Francisco, California 94133-4628
Phone: (415) 421-9292 x18

This case involved bodily injury to an individual as a result of the unexpected failure of a high-performance HDPE rope used in deep sea fishing and marine operations. I represented the plaintiff.

CASE 27:

John J. Song
Kirkland & Ellis LLP
601 Lexington Avenue, New York, NY 10022
T +1 212 446 5904

This case focused on a class action litigation involving the labeling and advertising of household textile products including bedding materials. I represented the defendant.

CASE 28:

Jay Sadd
Slaphey & Sadd LLC
Atlanta, GA 30328
T +1 404 255 6677

This litigation which dealt with a heavy equipment related accident that resulted in the death of the operator. I represented the plaintiff.

CASE 29:

Willmore Holbrow
Buchalter LLP
wholbrow@buchalter.com
1000 Wilshire Boulevard, Suite 1500
Los Angeles, CA 90017-1730
T (213) 891-5235

This case focused on alleged violation of a patented design for a hosiery fabric. I have assisted the defendants to prove that there is no patent violation involved.

CASE 30:

Michael K. Radford, Managing Attorney
Allen & Newman, PLLC
Nashville Office

P.O. Box 110099 | Nashville | TN | 37222

(615) 376-2288 ext. 1308

F: (615) 376-2608

M: (615) 477-8058

Email mradford@allenandnewman.com

This is an ongoing case which deals with supposed smoke damage to clothing materials. I am representing the defendant. The parties have entered negotiation phase.

CASE 31:

Carl R. Varnedoe, Esq.

Jones, Osteen & Jones

608 E. Oglethorpe Highway

Hinesville, GA 31313

(912) 876-0888

www.jojlaw.com

This case involved the death of three individuals and severe burn injuries to the fourth as a result of getting trapped in the interior of a shed that erupted in flames. The case argues that the presence of allegedly flammable building materials in the walls and ceiling caused the tragedy.

CASE 32:

Philip Marsh

Arnold & Porter

3000 El Camino Real

Five Palo Alto Square | Suite 500

Palo Alto, CA 94306-2112

650.319.4733

www.arnoldporter.com

This is a patent litigation involving textile structures designed to serve as shoe uppers.

CASE 33:

Melissa K. Zonne

Thoits Law

400 Main Street, Suite 250

Los Altos, CA 94022

650-327-4200

www.thoits.com

This litigation focused on the performance and durability properties of a knitted face mask fabric

CASE 34:

Attorney Ancel Escobar

KempSmith Law

221 N. Kansas | Suite 1800

El Paso, Texas 79901

This litigation related to moisture damage to clothing items caused by roof leakage in a Texas warehouse

CASE 35:

Attorney: Laura D. Schmidt

5700 Tennyson Pkwy., Ste. 300 Plano, TX 75024*

www.kellysmithhpc.com

This is an ongoing litigation related to unsatisfactory flammability performance of a flame retardant treated carpet.

CASE 36:

Attorney: Max Deitchler

Kutak Rock LLP

1277 E. Joyce Blvd, Suite 300,

Fayetteville, AR 72703-5585.

This is an ongoing litigation dealing with the injury caused by the unexpected rupture of a polyurethane polymer sheet used in a men's performance shoe.

CASE 37

Bryan Hauger, President

BHC Associates (Bryan Hauger Consulting, Inc.)

Working for Hauger's client, an insurance company

This is an ongoing case dealing with supposedly inadequate performance of flame retardant treated textile structures.

USEFUL ONLINE REFERENCES

MY INTERVIEW IN THE DECEMBER 2020 ISSUE OF LAWYER MONTHLY PUBLICATION:

<https://www.lawyer-monthly.com/2020/11/how-a-tiny-fibre-can-change-a-murder-case/>

LINKEDIN PERSONAL WEBPAGE:

<https://www.linkedin.com/in/dr-radhaKrishnaiah-parachuru-0960ba20/>

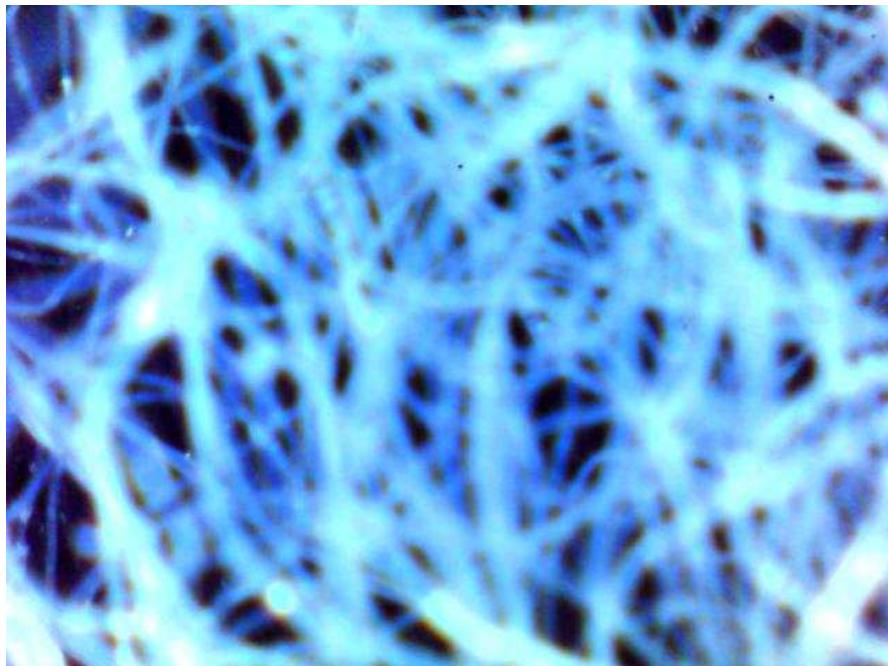
*** Litigation Involved Deposition**

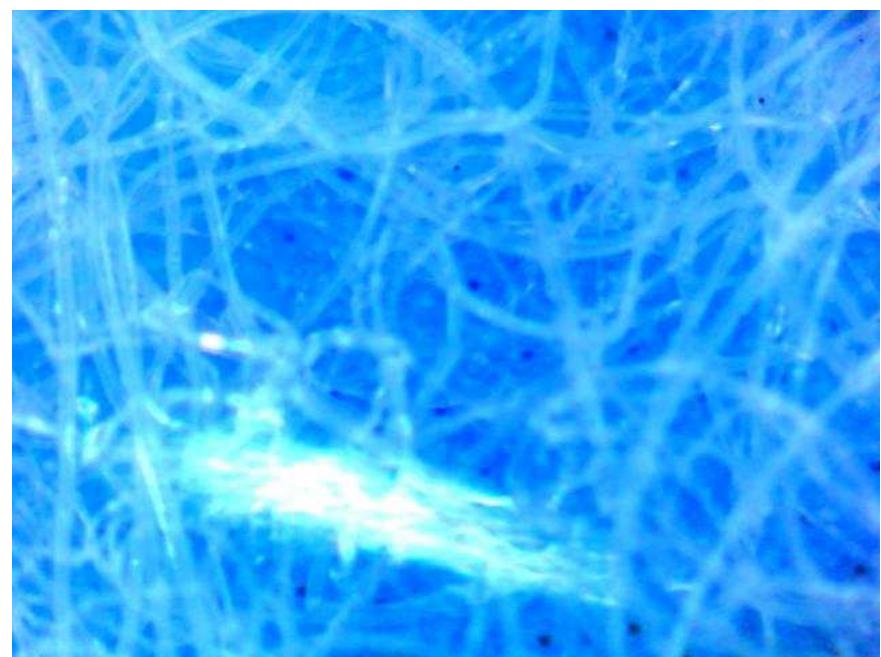
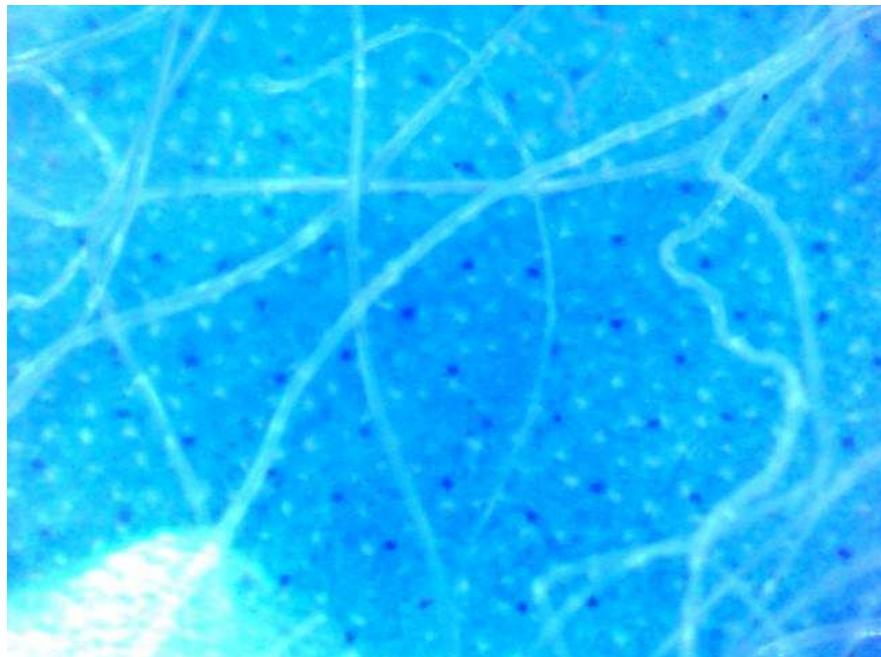
**** Litigation Involved Court-room Testimony**

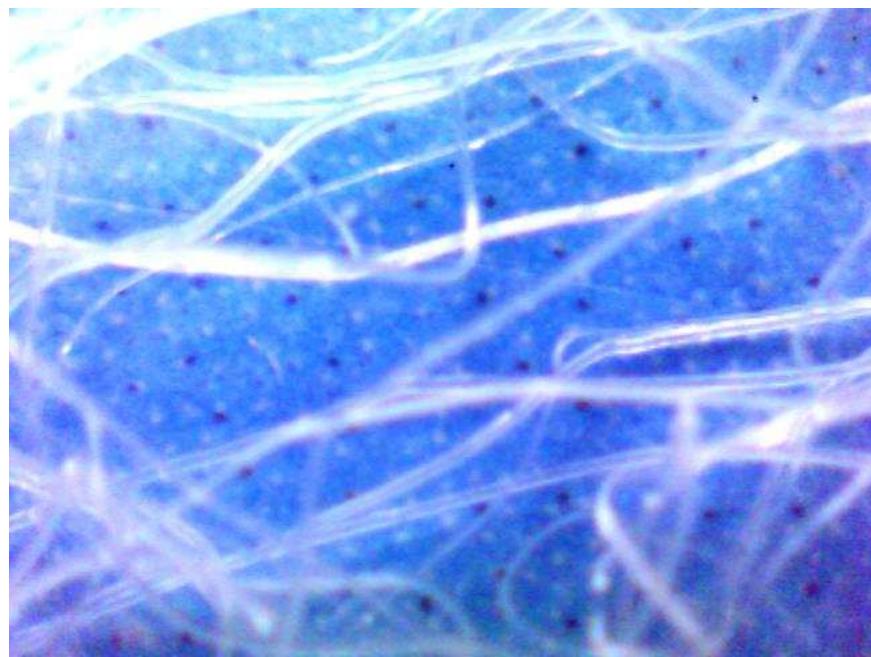
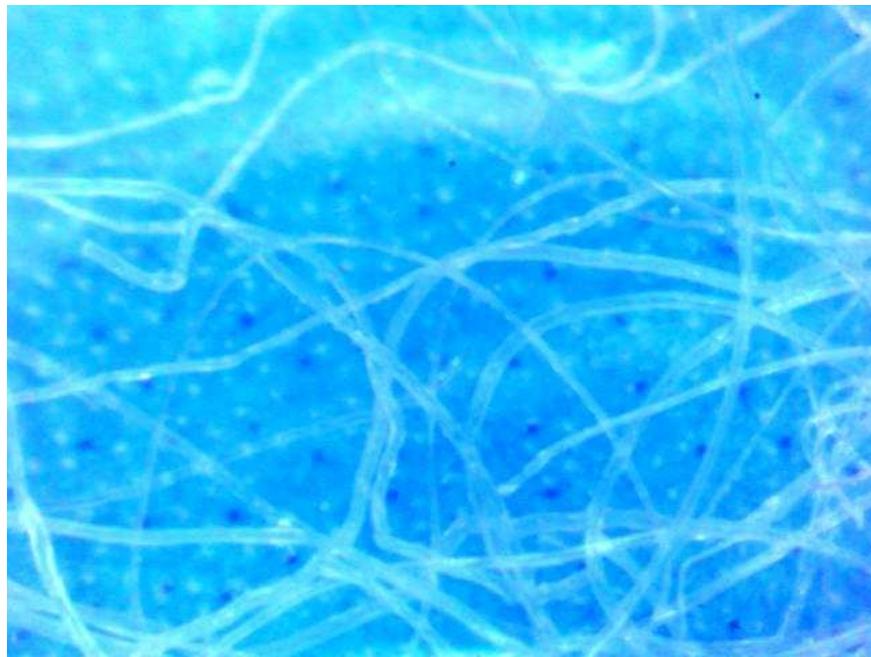
EXHIBIT C

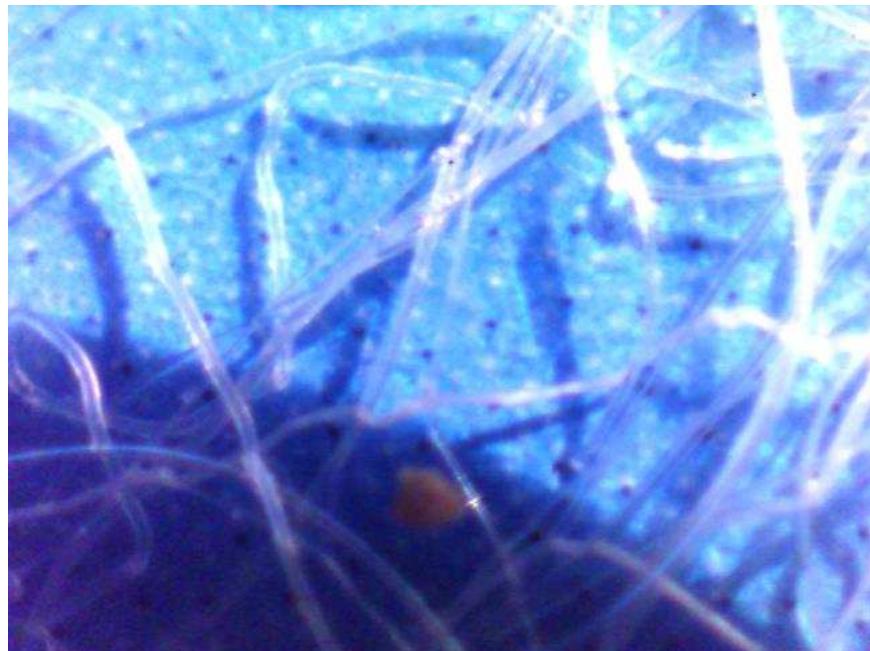
**Additional Images Taken During the Analysis of
RENEWLINER Samples 001 and 010**

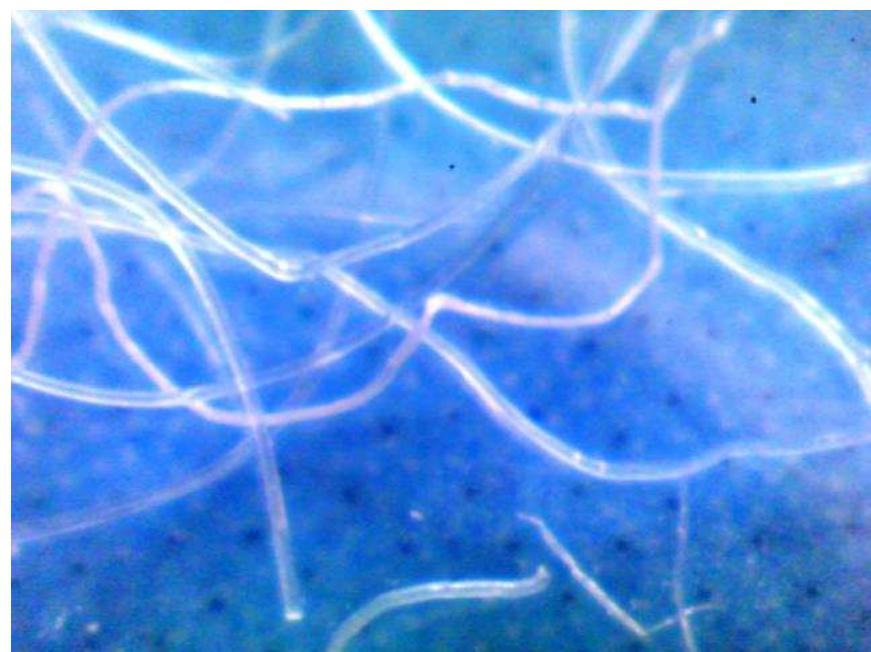
Images of 2023 Renewliner Sample (001) at 100x

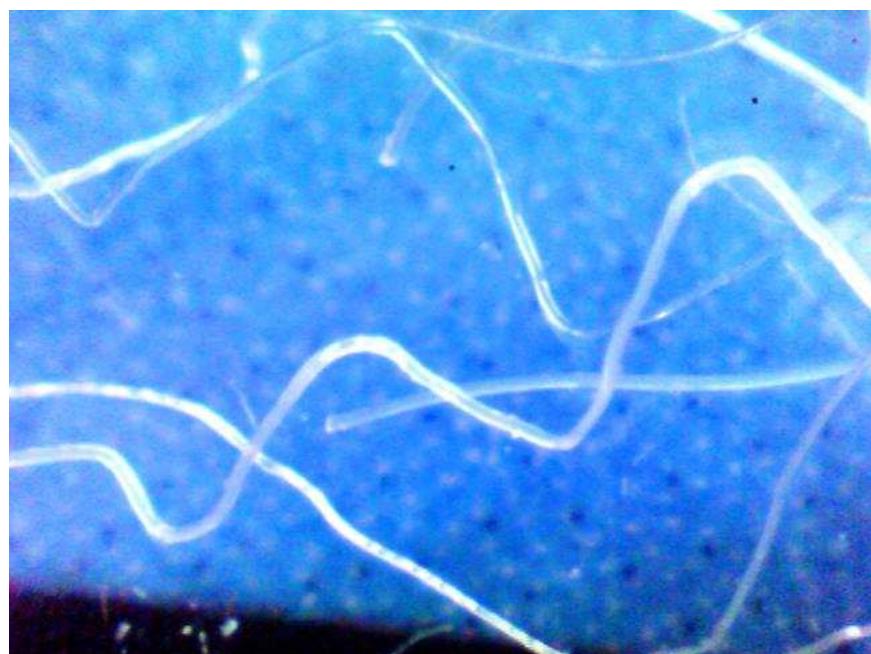
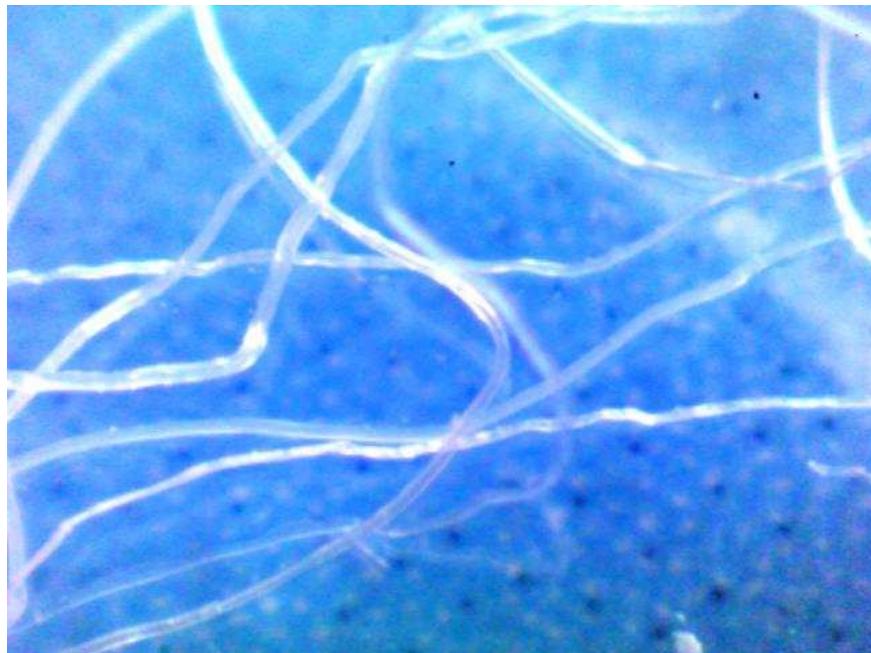


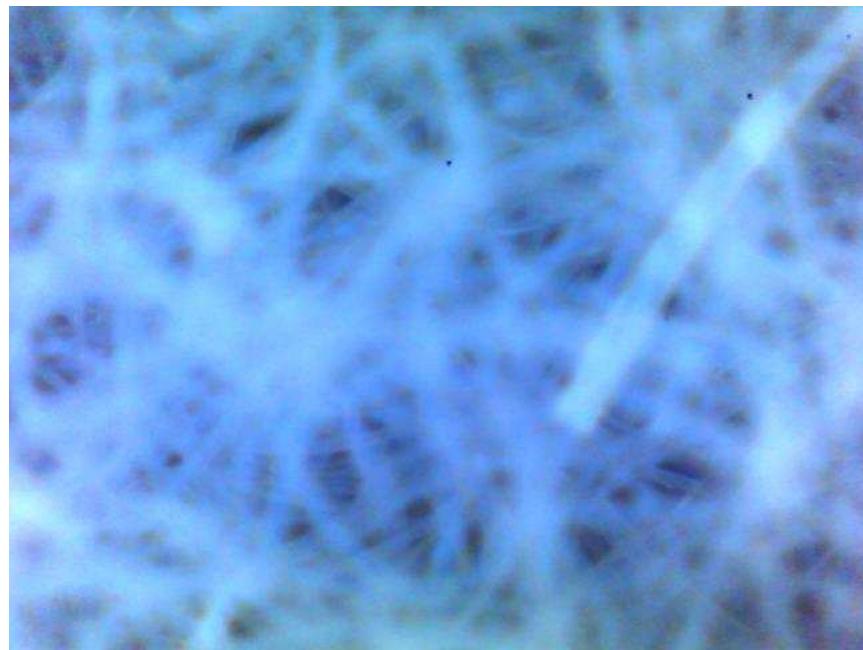
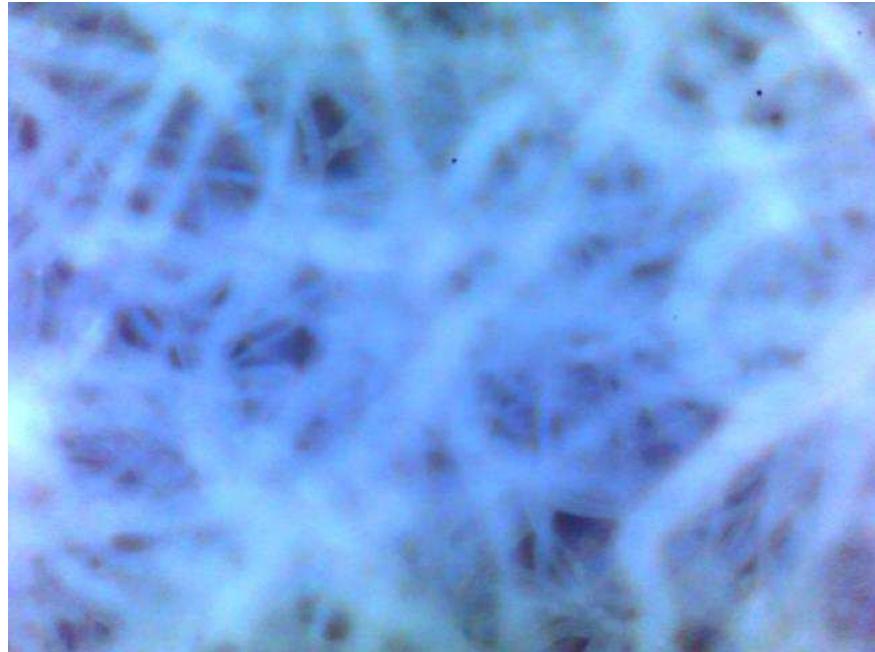


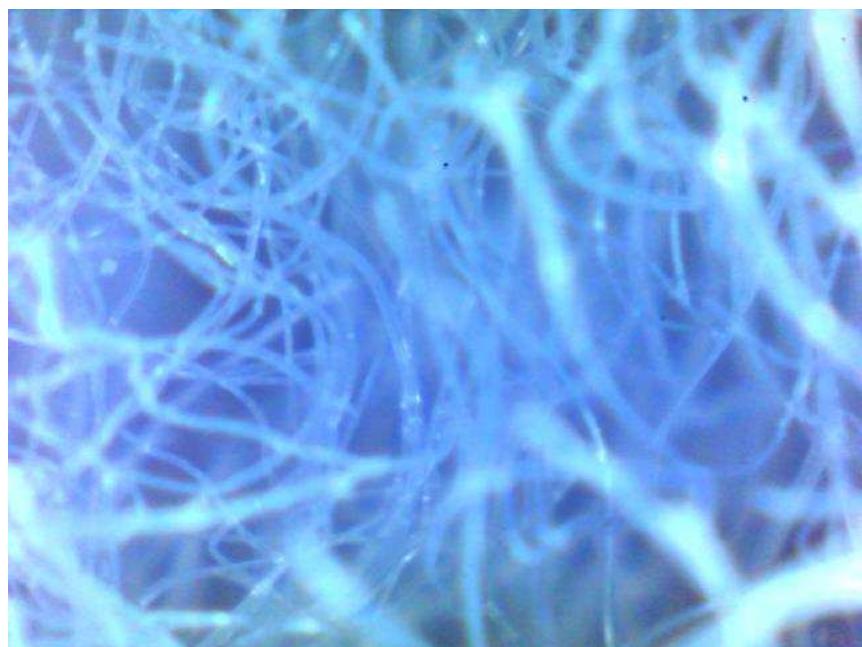


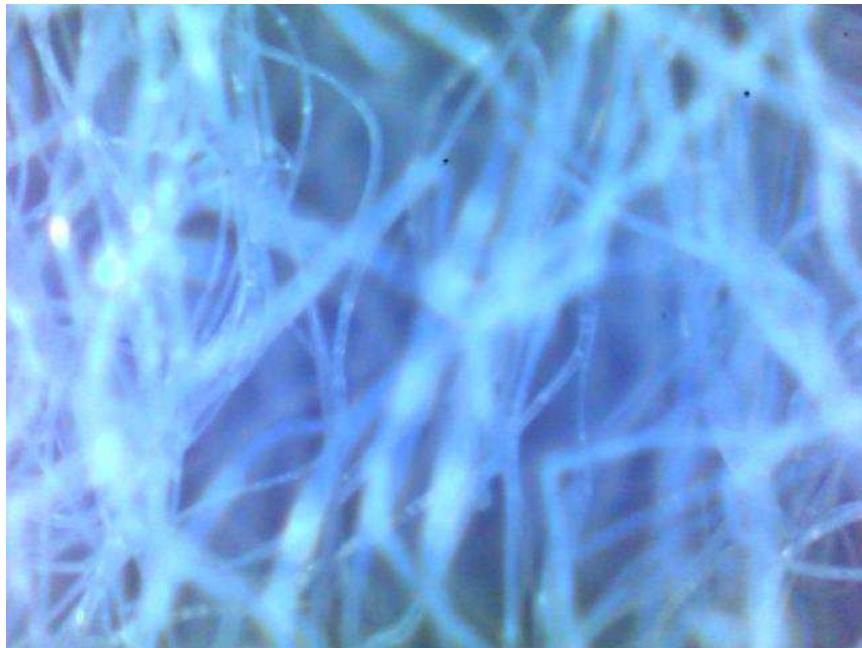
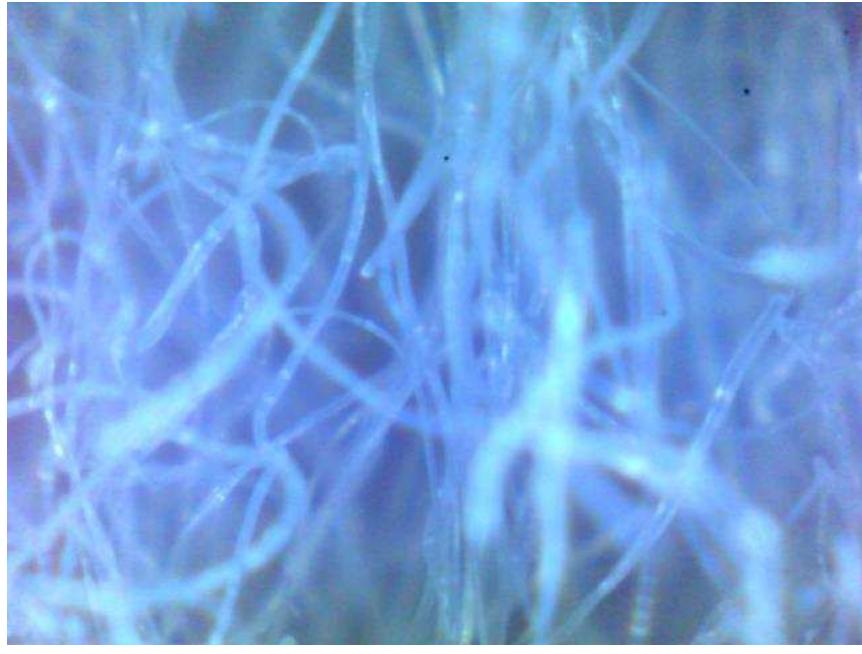


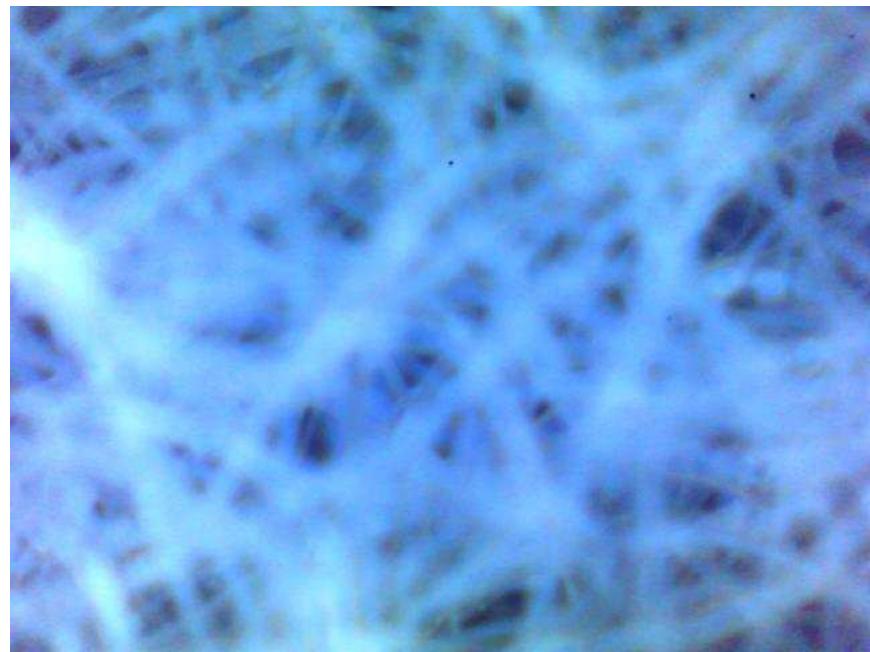
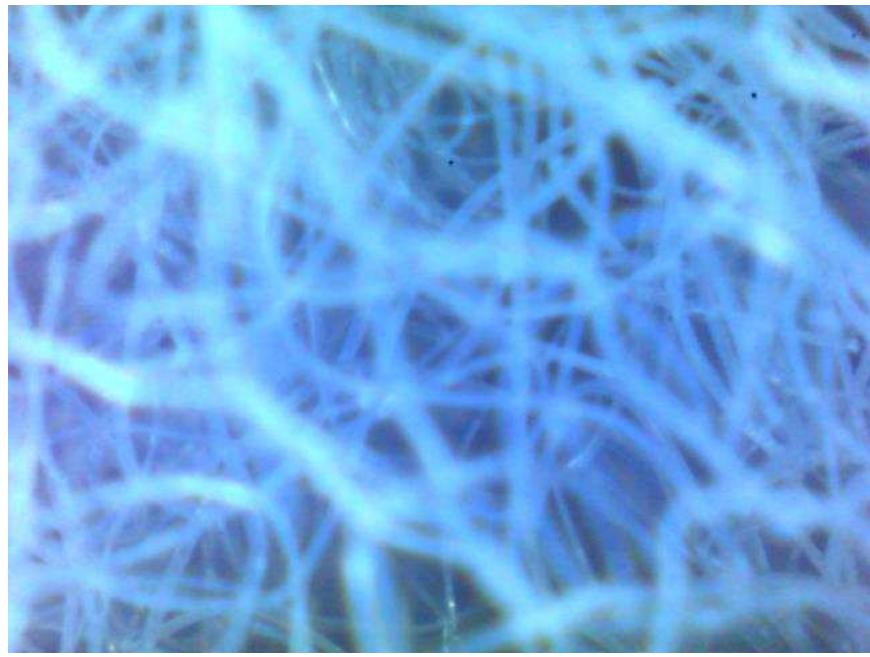


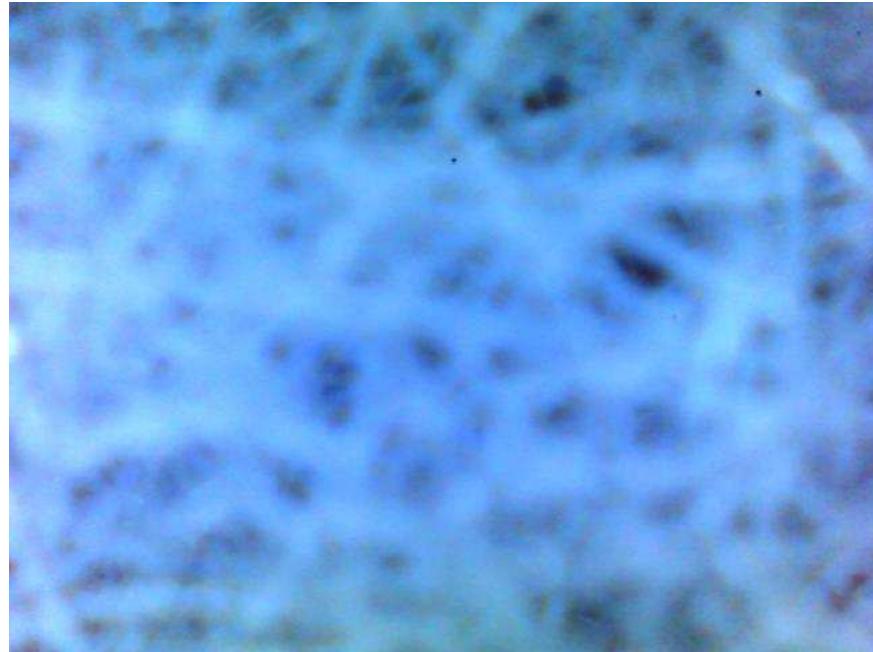




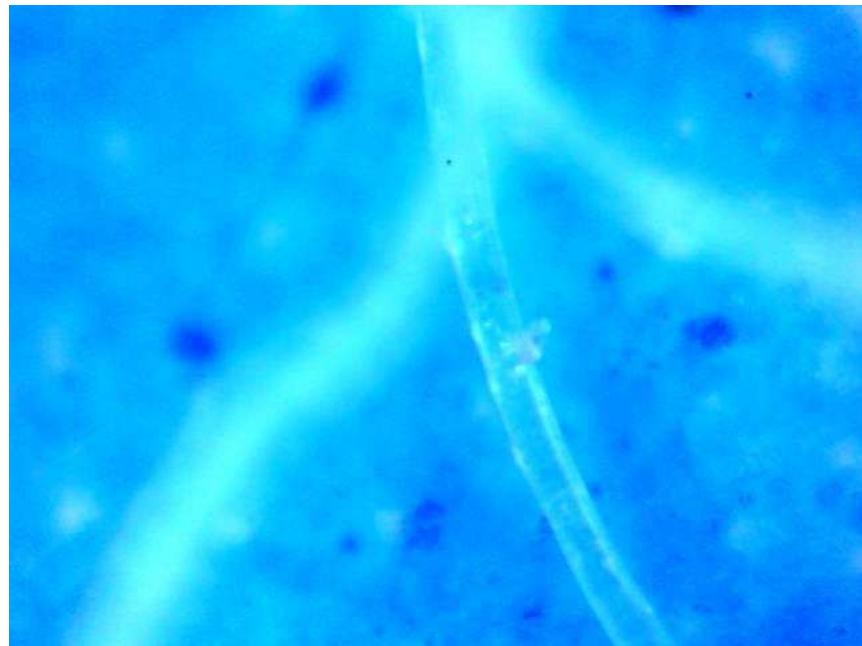


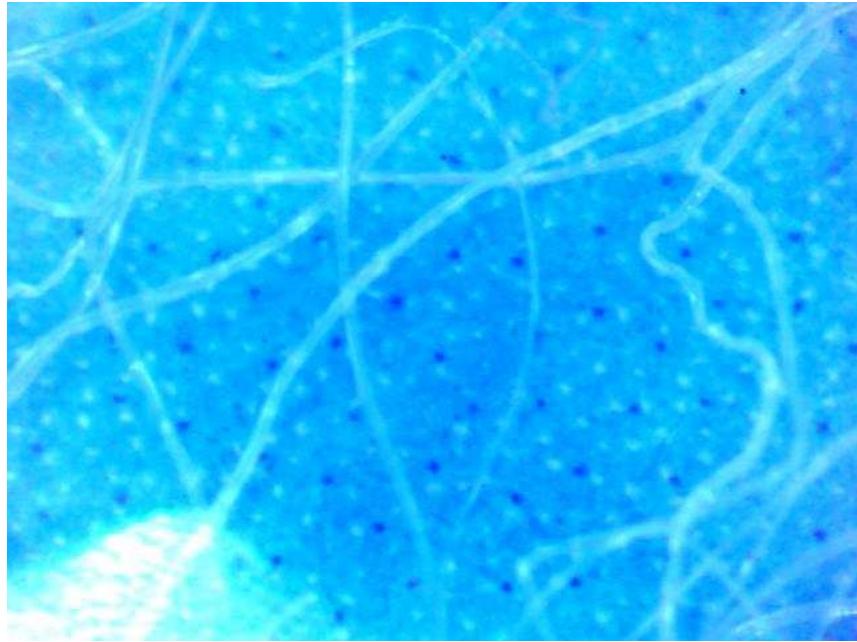




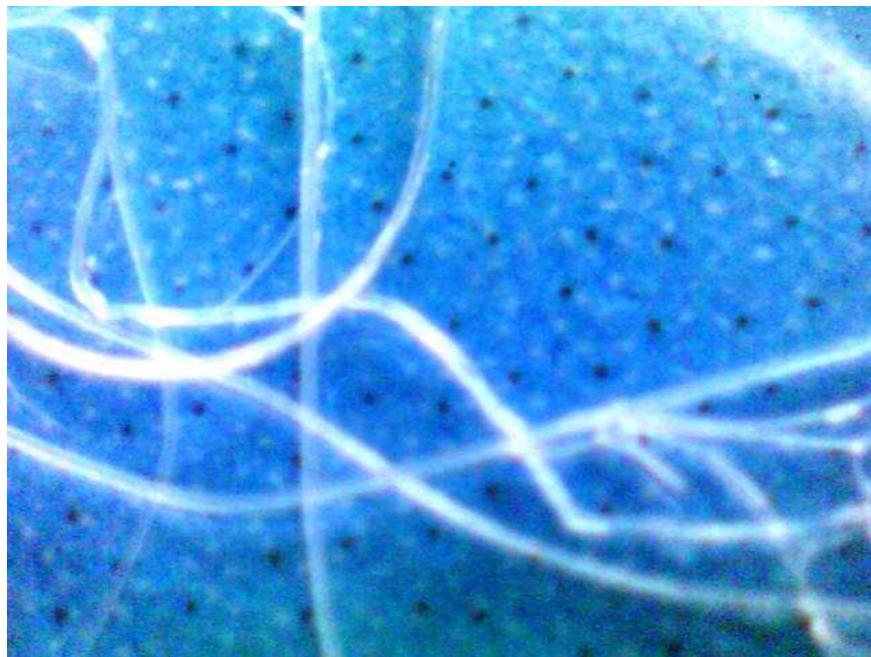


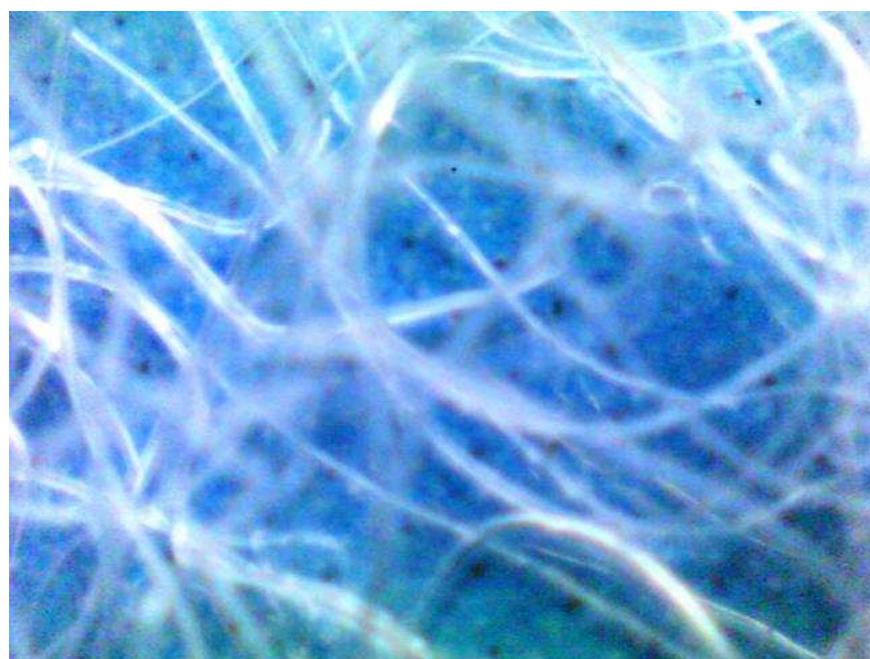
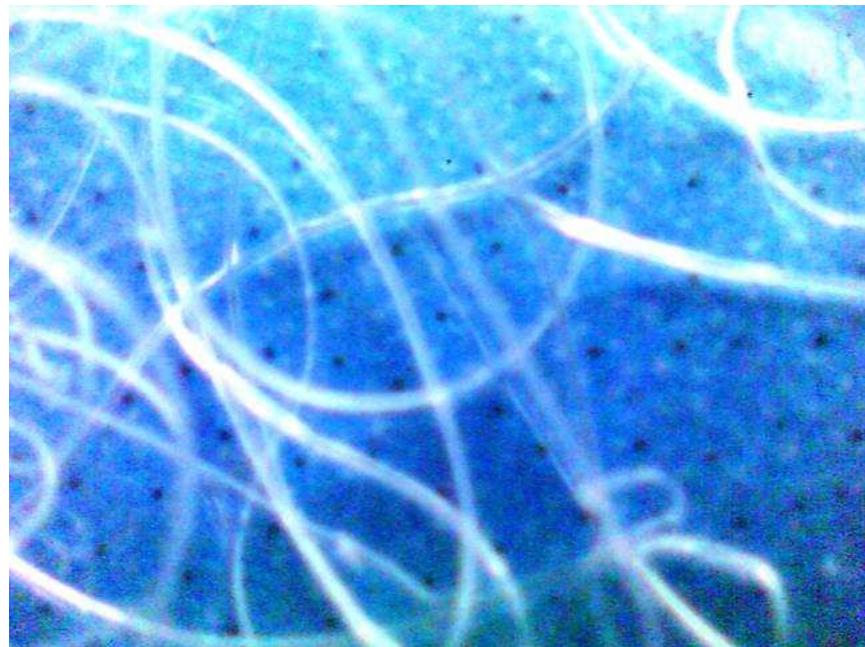
Images of 2023 Renewliner Sample (001) at 400x

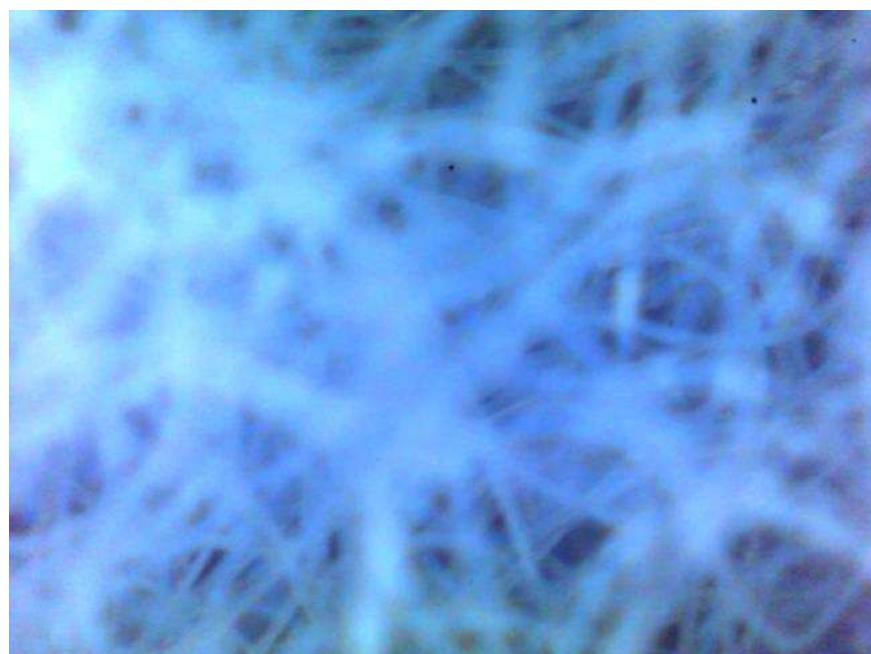
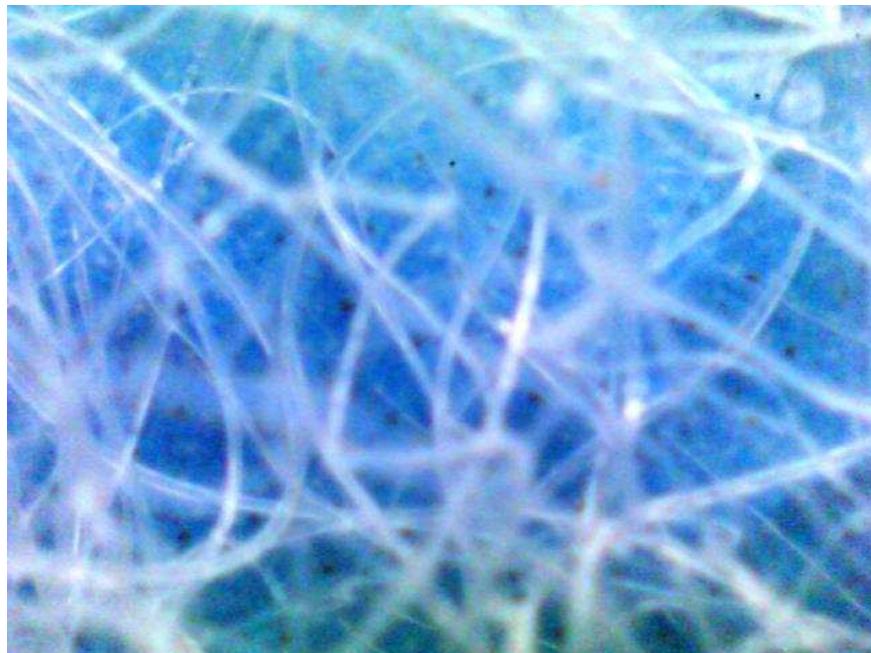


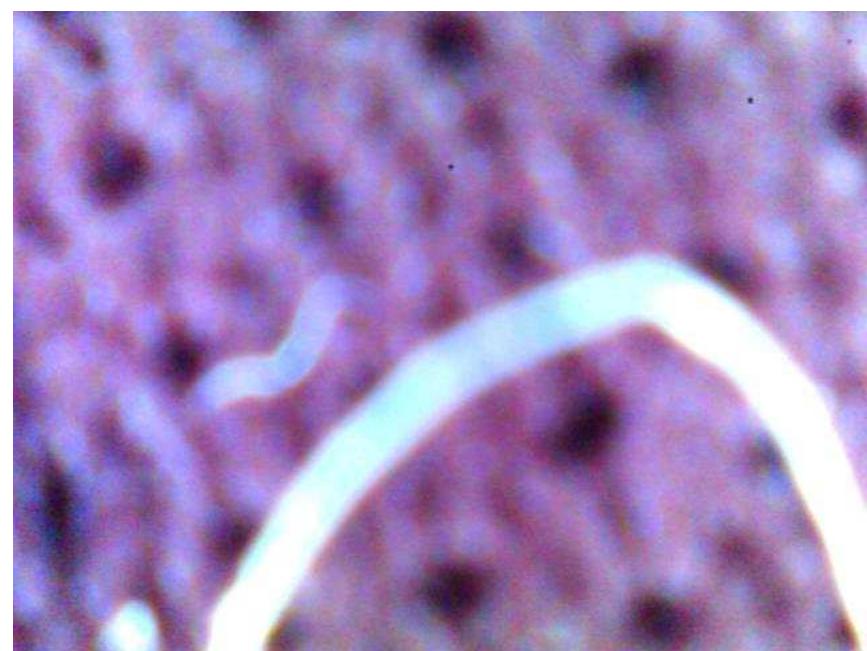
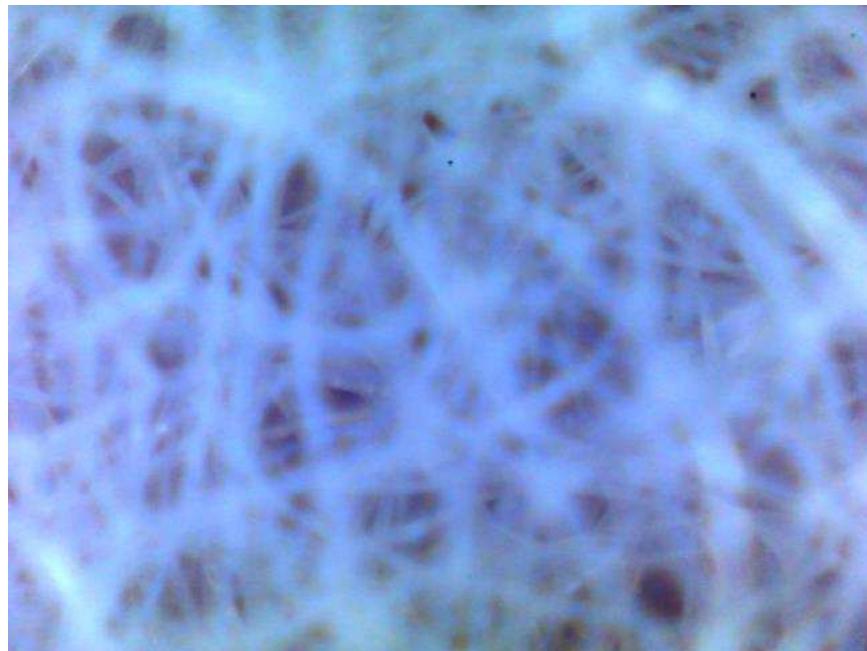


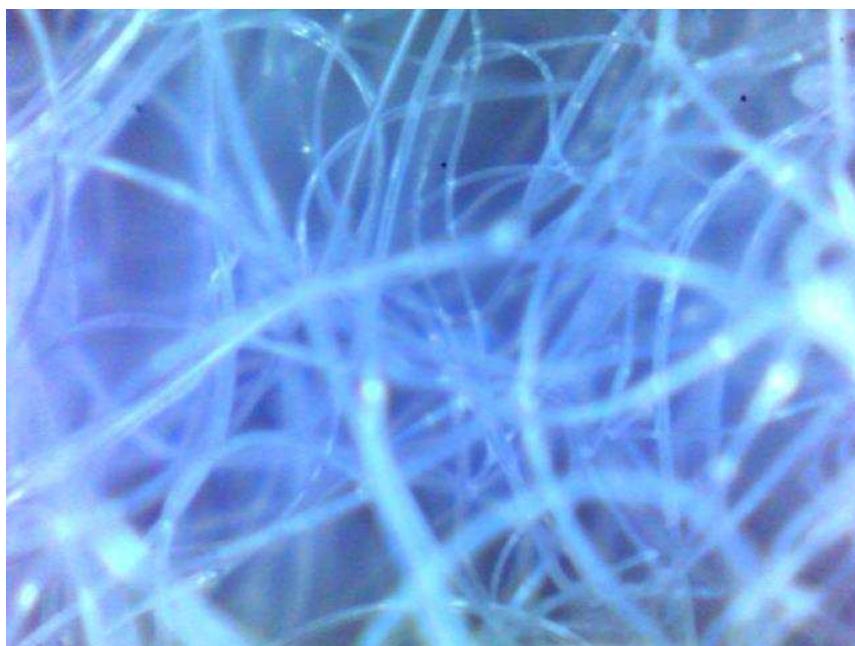
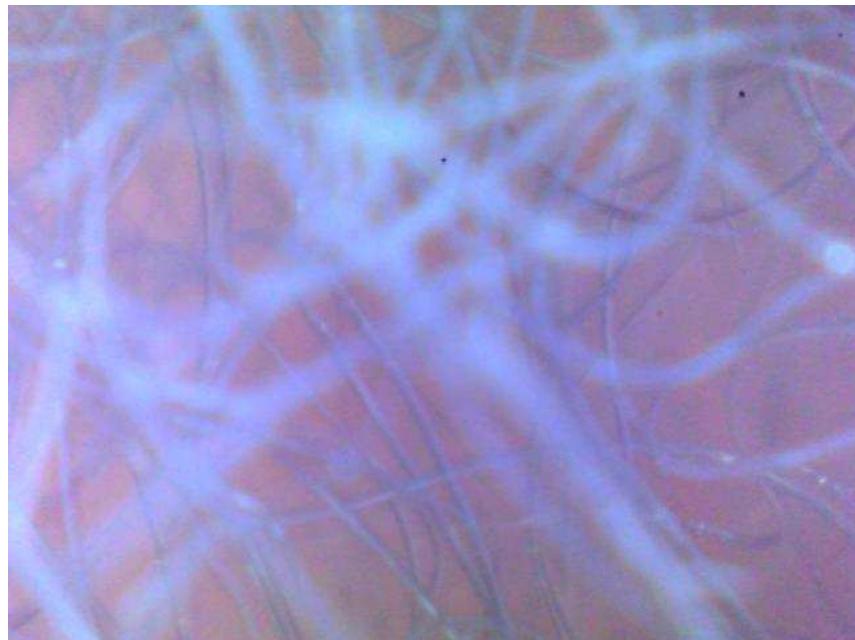
Images of 2016 Renewliner Sample (010) at 100x

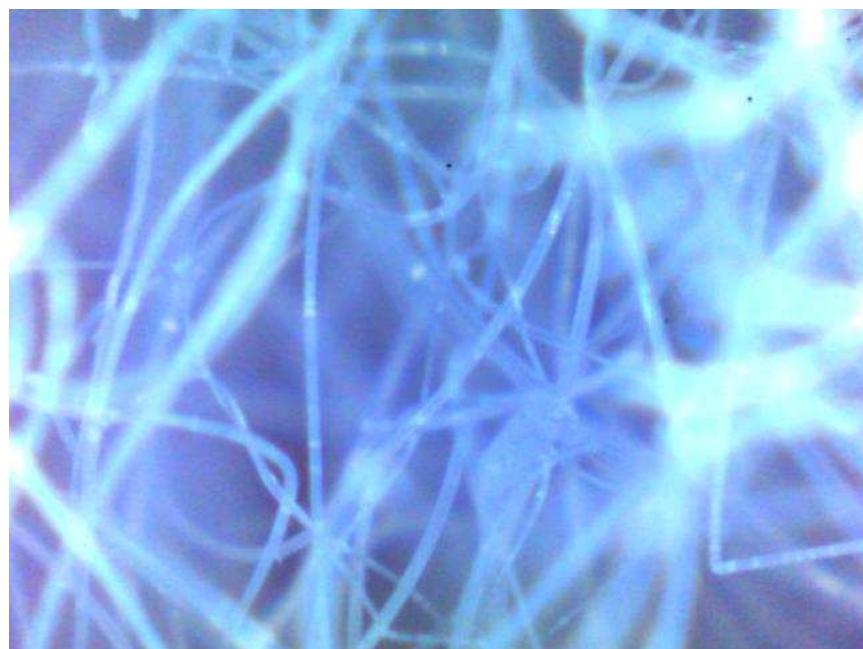
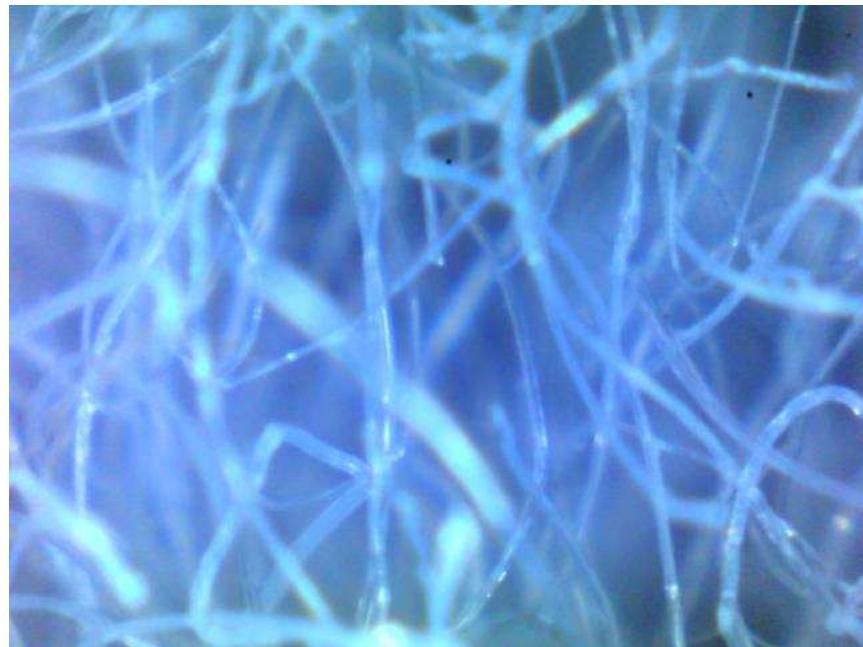


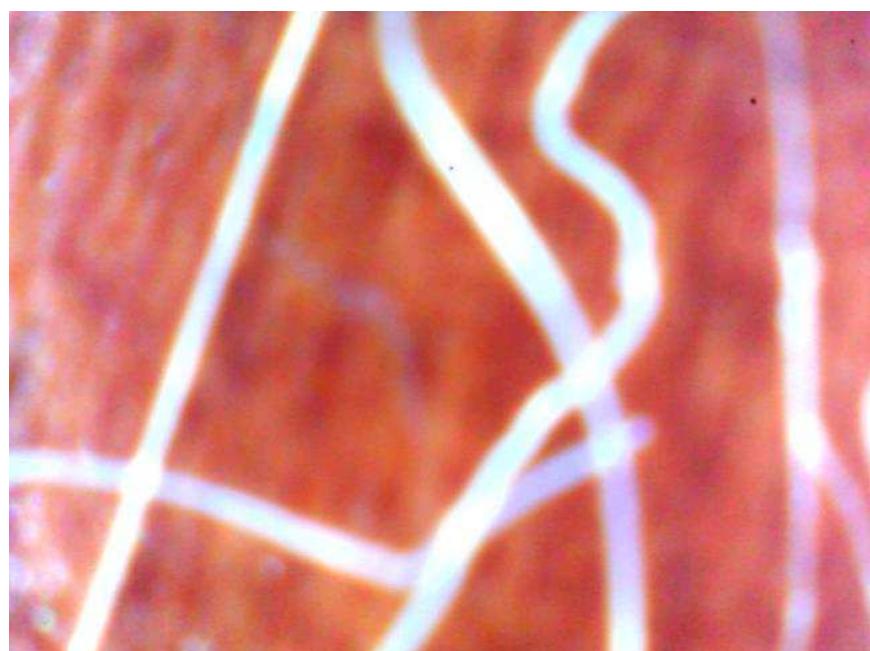
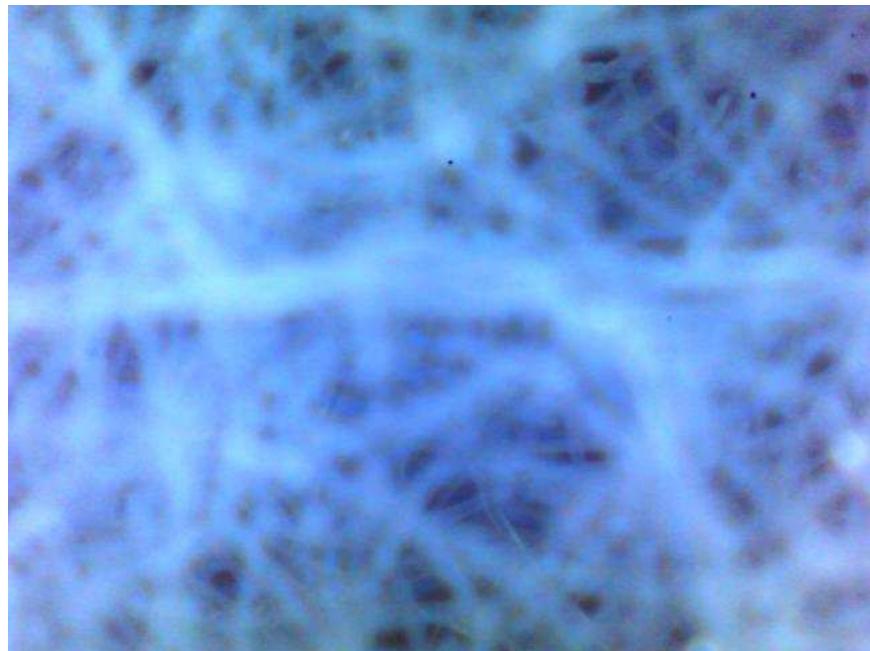












Images of 2016 Renewliner Sample (010) at 400x

